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QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment.

The Current Issue.

A survey of the agricultural position in Queensland and a review of matters affecting our rapidly increasing dairying industry are among the more important features of this issue. Systems of irrigation are discussed in a further instalment of Mr. Eklund's notes. The Tamworth breed of Pigs is Mr. Shelton's subject this month. Growing interest in forestry problems has suggested a very interesting summary of "Eucalyptian Facts," which will be appreciated by all who are impressed with the value of our first and one of our greatest crops—our native forests. A valuable paper on insects affecting sugar-cane will be read with interest by all concerned in applied entomology. Another useful January feature covers notes on insects injurious to cotton. The regular features of the Journal extend over a wide field and as usual good illustrations add value to the contents.

The Sugar Industry—Research Scholarships.

The Acting Premier and Minister for Agriculture and Stock (Hon. W. N. Gillies) has announced that Executive approval has been given to a scheme which may be designated as the first practical step towards the conjunction of the scientific training of the University with the agricultural industry. The proposal was first made by His Honour Chief Justice McCawley, who is also a member of the Senate of the University, and covers briefly the institution of three travelling scholarships for scientific research work for the benefit of our great sugar industry. The proposal was accepted by the Government and to it has been added advice from the University, the Public Service Commissioner, the Central Sugar Cane Prices Board, the Council of Agriculture, the Australian Sugar Producers' Association, the United Cane Growers' Association, the Director of Sugar Experiment Stations, and the General Manager of the Sugar Bureau. The Government has decided to provide three travelling scholarships each of the value of £300 a year and tenable for four years, open to general competition, but preference may be given to students of the Queensland University who possess a science degree. One scholarship will be for Sugar Engineering and Chemistry, one for Plant Pathology, and one for research in Soil Problems. The holders of the scholarships will have to devote themselves for the first year to studying the sugar industry in Queensland, and thereafter undergo training at such

places and institutions abroad as the Minister for Agriculture may decide. The cost of the passage to and from the place chosen abroad will be paid to the holder of the scholarship, and, of course, there will be the value of the scholarship—£300 a year. Each scholarship holder will also be required to sign an undertaking to enter, at the expiration of the term, the employment of the Department of Agriculture on work pertaining to the sugar industry, for at least four years, in any part of the State, with remuneration at a rate of not less than £300 a year.

Co-operative Marketing Associations Act.

The Primary Producers' Co-operative Associations Act provides for the formation, registration, and management of primary producers' co-operative associations. Its provisions are now in operation. This is a measure of much importance to the farmers of Queensland, and the Acting Premier and Minister for Agriculture (Hon. W. N. Gillies), who is charged with the administration of the Act, in the course of a recent Press interview, said that farmers justly complain that in seasons when production is heaviest, prices are lowest, and *vice versâ*. If prices are to be stabilised distribution must be organised. The outcome of all experience in handling farm produce is that this can be best achieved through co-operative marketing which really means the co-ordination of growers' interests in very widely separated localities, and the creation of a central selling body. The most common form of co-operative marketing practised in most countries to-day is co-operative pooling, or organisation on a commodity basis. Such bodies acquire a legal personality under the provisions of the Queensland Act, and must conform to the rules of management prescribed by it. Under our Companies Act there is no basis of control other than the amount of capital subscribed. It contemplates no other means of control. Under it the rights and obligations of producers' co-operative societies are not clearly defined. The purpose of the new legislation is to remedy these deficiencies. For example, such associations must have the right to make the voting power of its members equal, or in ratio to the amount of produce purchased or contributed. The Act gives this power. Again, associations must be able to control the transfer of shares in order to ensure that every member shall be a producer or purchaser directly interested in the services which the association performs. The Act provides a means by which a member may disconnect from an association when he ceases to be a contributing producer, a provision rendered necessary in order to prevent control passing out of the hands of producers. One of the outstanding features of the measure is that it provides that the agency itself conducting the business must be composed of and managed by the active producers of the commodity handled, and its benefits returned to them in proportion to the use or patronage of each.

Activities are restricted to the primary purposes of the organisation, with each association having a marketing problem common to all its members. The bond of association is a contract voluntarily entered into by each member, thus assuring a definite volume of business, and careful grading is a corollary permitting of the payment of accurate and average prices.

These associations will render service at cost, and, generally speaking, they will make no profit, pay no dividends, and accumulate no surplus. As they will handle mainly perishable products price-fixing will not be practicable. There is no element of compulsion in this measure. Its provisions contemplate voluntary associations brought into being to give effect to principles of self-help and mutual service. It is designed to facilitate collective effort for a purpose, having many conspicuous advantages over unaided individual effort.

The entire working capital of a co-operative association must be either owned or borrowed by the association, and the Act contemplates a plan by which the capital contributions of members are kept permanently proportioned to the uses they make of the organisation. The supplier contributes on the basis of his previous year's business, and the shares he receives will bear interest. Students of co-operation have described the method of finance provided for in the Act as the best that has ever been devised for capitalising a co-operative association.

A questionaire on the provisions of this measure is being prepared by the Council of Agriculture and will shortly be published. This course has been rendered necessary as many of the provisions of the measure are not rightly understood, and as a result they are being misrepresented. The provisions of this measure creams the working experience of co-operation in other countries, and there is nothing experimental in its make-up. Every principle it embodies is to be found on the statute-book of some one or more countries of the world, and their existence justified there. Criticism that does not recognise this is ill-informed.

QUEENSLAND AGRICULTURE IN 1923.

By H. C. QUODLING, Director of Agriculture.

Subjoined is the report of the Director of Agriculture (Mr. H. C. Quodling) taken from the Annual Report of the Under Secretary for Agriculture and Stock (Mr. Ernest G. E. Scriven) to the Minister (Hon. W. N. Gillies) for submission to Parliament.

Effect of the Indifferent Season.

A retrospective view of the yields obtained during the past year—1st July to 30th June—from the principal classes of crops grown, indicate that the season generally, both prior to and after 1st January, left much to be desired. As a matter of fact it was, from the standpoint of average yield, one of the State's "low" years. Certain districts were more fortunately situated and better favoured in the matter of rain, and correspondingly improved yields were obtained. Spring rains, however, which were of vital import to the main wheat crop, proved erratic and favoured the southern end of the Darling Downs more so than anywhere else in the wheat belt. The capriciousness thus shown was evidenced even in a more marked degree during the summer, as February established the unenviable reputation of being the driest month for a period of nearly half a century.

The Effect of the Dry Spell on Maize and Cotton.

Any crop (other things being favourable) which stood up as the cotton crop did to a check of this character, and revived when rain fell soon after, in March and April, is worthy of more attention than the average farmer usually bestows upon it. This natural ability possessed by the cotton plant, not only to live but to produce a crop, was in marked contrast this season to maize, which, in Southern and Central Queensland, suffered generally during the abnormally dry spell owing to the inability of the plant to meet the excessive evaporation from its leaf surfaces. Evidence of this character obviously indicates that cotton is a more dependable crop than maize in districts of medium rainfall, and emphasises also the necessity, from an economic standpoint, of encouraging a system of mixed farming in such districts, so that bulky crops like maize, if they fail for grain, can be profitably turned to account as food for dairy stock.

The Extraordinary Development of the Cotton Industry.

As far as the cotton industry is concerned, the past year has been one of the most important in the history of the State, as it marks an era of development unique in its well-ordered progress towards a definite goal. The British Cotton Delegation, which toured the Central and Southern districts last October, was the means of giving very wide publicity to Queensland as the premier cotton State.

In the first place, growers were assured of a certain market for their seed cotton under the Government guarantee; and secondly, under the agreement between the Government and the British-Australian Cotton Association, ample facilities were provided, at the several modern ginning factories erected for this purpose by the company in question, to treat all the cotton that could be grown during the season. Concurrently with this very necessary development, the same company has been busily engaged in expanding its business by the construction of a large cotton-seed oil extraction plant in Brisbane, capable of treating 80 tons of seed per day.

Good reasons exist for an optimistic view of the whole situation connected with cotton, as the expenditure of at least a quarter of a million sterling in the developmental works already referred to has placed the industry in the best possible position to carry on; and it is a coincidence worthy of note to record the fact that the value of the year's output of cotton is estimated to reach and possibly to exceed the sum named. This Department's action in securing the services of two cotton advisers, Messrs. W. G. Wells and G. Evans, from the U.S.A. and India, respectively, proved most opportune, as many matters vital to the existence of the industry required their attention.

Land Settlement Schemes.

A feature of the year's work has been the co-ordinated effort in committee of this Department with the Lands Department in connection with settlement schemes. A good deal of the time of different officers has also been taken up on occasion in making inspections of land and reporting on its quality and capabilities, and as a result it is satisfactory to note that the information furnished has proved of value.

Prickly-pear Commission.

Officers of my staff have also supplied special reports asked for by the Commission.

Agricultural Council.

Activities in connection with the council, and standing committees attached thereto, have absorbed an appreciable amount of time during the year. Probably the most important recommendations made through this office were those relating to an amalgamation of existing Acts governing advances to settlers and the liberalisation of advances to persons engaged in primary production.

Exhibitions.

Empire.—The work of collecting non-perishable material was proceeded with during the year, with the result that some fairly satisfactory samples of cereals and grain have been placed in store.

Royal National.—The Department made a comprehensive display last August, which served the twofold purpose of advertising the activities of the various branches of the Department and showing also the great variety of products that can be grown in Queensland.

Maize.

In North Queensland the season proved generally satisfactory, and good yields of grain are expected on the Atherton Tableland, both from "forest" and "scrub" lands. Interest has been revived in a storage and drying scheme to supersede the existing system of holding grain over in galvanised iron tanks, a method which involves a good deal of labour.

Assistant Agricultural Instructor Wise, who is stationed on the tableland, was provided with a "Brown Duvel Moisture Tester," and has been actively engaged in collecting data respecting the moisture content of grain samples taken under varying conditions from field, barn, bag, and tank.

In Central and Southern Queensland, the main crop of maize was more or less a failure. Certain districts were favoured with good rains and correspondingly good yields were forthcoming; outside the coastal belt, however, the weather conditions were generally unsuitable for the production of grain. Rains were too light to reach to any appreciable depth in the soil, and when hot weather set in in February (the driest February for the last fifty years) the crops wilted beyond recovery as a grain proposition and were generally useful for milch cows. Under the circumstances fairly high prices have ruled, with the result that speculators secured large parcels of South African maize. Importations of this character place the Queensland maize-growers, and the Northern ones in particular, at a very great disadvantage.

Improvement in Type and Yield of Maize.

Technical work and the practical application of same towards the improvement of this important cereal have been continued throughout the year by Mr. C. J. McKeon, Assistant Agricultural Instructor. The indifferent season interfered with the programme laid down and curtailed to some extent certain extension work, but it is gratifying to note, from reports furnished in connection with plant selection, that a gradual improvement has manifested itself and a greater uniformity in desirable field characteristics has been attained.

Field-work was arranged in the Kilcoy, Boonah, Beaudesert, Kandanga, Imbil, and Yandina districts. Thirty separate plots were established, totalling upwards of 120 acres. Certain crops situated in drought-affected areas either failed or only produced light yields. Where the season was more of a satisfactory nature correspondingly improved returns were forthcoming:—Funk's 90-day yielded 30 bushels per acre at Beaudesert. Early varieties (4 months):—Funk's and Reid's Yellow Dent each yielded 40 bushes per acre at Beaudesert and Boonah respectively, but the former-mentioned variety gave a 50-bushel-per-acre return at Imbil, where the season was a reasonably good one. Improved Yellow Dent (a 5-months corn) also proved its capacity to produce heavy crops in the Imbil district, three separate areas being harvested for yields of 68, 75, and 90 bushels per acre respectively. Star Leaming (4-months' corn) gave the high yield of 80 bushels per acre at Kandanga.

The system of carrying out "Ear to row" tests, to segregate high-producing strains typical of each individual variety, was continued. The above figures are eloquent of the value of this class of work from the standpoint of production. Every effort is being made to bring these proved varieties into general cultivation.

Wheat.

Last season the Darling Downs, which is the principal wheat-producing area, experienced an indifferent season. Striking examples were to be seen in practically every district illustrating the benefits derivable from early and systematic preparation of the land for cropping purposes. One disability which many growers had to face was the late germination of self-sown wheat and wild oats, the eradication of which delayed wheat-planting sufficiently in some instances to have an effect of retarding the normal period of development and yield of the wheat crops.

The Allora district appeared to be better off for rain than any other locality, and yields were correspondingly higher. Here the rainfall for six months, June to November, was 13¾ inches as against the much lower registrations elsewhere on the Downs. The Inglewood rainfall was less by several inches than that of Allora, and the Maranoa record was even lower than Inglewood's. Speaking generally, the wheat-growers had an unprofitable year, those on the heavy soils of the Maranoa particularly so; evidence of the droughty conditions may be gauged from the fact that for a twenty-week period ending 31st May, 1922, less than 1 inch of rain was recorded. Good germinating rain fell in June, but for the next fourteen weeks the registration amounted only to 58 points. Good rains, however, fell in October, too late, unfortunately, for the wheat crops in that particular district, which usually ripen at this time.

Improvement in Existing Varieties.

"The Seed Wheat Improvement Scheme," instituted by the Department with the co-operation of the Wheat Board, was continued. In the face of a late planting and the irregular season, the results were consistently good, as will be noted from the undermentioned summary:—

Quantity.	Variety.	Average Yield per Acre.
Acres.		Bushels.
48	Roma Red (2)	$27\frac{12}{60}$
36	Cedric	$25\frac{43}{60}$
163	War Chief	$22\frac{29}{60}$
73	Roma Red (5)	$21\frac{37}{60}$
134	Novo	$21\frac{24}{60}$
69	Roma Red (7)	$20\frac{37}{60}$
Total 523		$22\frac{32}{60}$

The highest yield recorded was 40 bushels per acre, Roma Red (2) in the Allora district.

It may be explained, briefly, that a classification of wheats was made for different districts and soils found therein, with a view to standardising types of grain. The above-mentioned tests represent extension work of the Field Branch with varieties raised at the Roma State Farm. With surplus supplies of pure seeds made available by growers to the Wheat Board under agreement, the latter body would be placed in the position of calling up the less dependable varieties in cultivation, for gristing purposes, and substituting clean, graded seed of a standard type.

Demonstration Plots.

The policy of establishing plots of this description in advance of settlement assumed definite shape. In the Upper Burnett, a central camp was established near Monto, on Mulgeldie Station, about 70 miles from rail-head, and placed in charge of Mr. Field Assistant L. W. Ball. Four small areas of land were selected within a radius of 2½ miles of the camp, typical of different classes of country—a scrub-covered area of 40 acres close to the township site; an alluvial area of 20 acres, ringbarked (gum country), on Three Moon Creek; and two other 10-acres blocks, one on Hurdle Gully (cultivable land) and the latter on second-class grazing country which it was considered might be used for hardy crops.

A climatological station was established so that data would be available. A number of interesting trials were carried out with different crops, and included a special series of plant-spacing tests with Durango cotton. Results from the 40-acre area of scrub land (brigalow principally, with a little softwood) proved most satisfactory. The area was enclosed with a wallaby-proof fence after felling and subsequent burning off, and an excellent stand of Rhodes grass obtained, fit for stocking within twelve months of the time the scrub was felled.

Land-seekers, unfamiliar with the district, who visit the Upper Burnett when the time comes for the inspection, will be able to form a fairly accurate idea of its capabilities. This scrub block should prove particularly valuable as an object lesson; development costs are available and can be applied to an area of possibly 100,000 acres of somewhat similar land in the Upper Burnett. [A report on these plots covering results of crop experiments will be published in next Journal.—Ed.]

Another site for a demonstration area was chosen in the Callide Valley. Initial work was commenced in order that land may be prepared for the approaching season's cotton crop, the intention being to undertake crop-spacing and fertiliser tests, and "place selection" of strains of cotton suitable for the extensive tracts of alluvial country about to be thrown open for selection in this valley.

General Experiment Crop and Crop Demonstration Work.

This class of work is closely allied with the activities and duties of agricultural instructors. A number of plots were established during the year. In the Central District (Boyne Valley) the results of the fertiliser tests with wheat, rye, oats, and skinless barley (totalling 56 plots) were marred to some extent by the irregular season. Oats failed. Wheat as a fodder crop showed to conspicuous advantage, the yields in the generality of cases being fully a ton higher per acre than the other crops, the highest yield being 5.14 tons per acre (3 cwt. meatworks manure per acre). Blood manure (2 cwt. per acre) gave the best average return, followed successively by meatworks manure (3 cwt. per acre) and a combined fertiliser, basic super (2 cwt.), potash (1 cwt.), and nitrogen (blood, 1 cwt.).

Two other winter fodder crop trials at Rosedale and Mount Larcom furnished better returns. Ten plots comprising two varieties each of oats and barley, four of wheat, and two of wheat and field peas (combination crop) yielded, the oats excepted, from 7.2 to 9.2 tons and from 5.8 tons to 8.7 tons per acre respectively. Ruakura rust-resisting oats showed superiority over Algerian oats, yielding 7.4 and 6.0 tons at Rosedale and Mount Larcom, respectively, whilst the Algerian failed at the former place and only returned 3 tons per acre at the latter.

A number of varieties of root crops, onions, and sorghums were tested in several districts.

AUSTRALIAN WHEATS.

The Director of the Institute of Science and Industry, Sir George Knibbs, draws attention to the issue of a new bulletin on the classification of wheat varieties, which has just been published by the Institute. This bulletin is a revision and extension of one published by the Institute in 1920, and like it has been prepared by the Special Committee on Seed Improvement, under the chairmanship of Mr. A. E. V. Richardson, Director of the School of Agriculture, University of Melbourne. It contains information of a practical and scientific nature on eighty-two of the most important Australian wheat varieties. The first portion is concerned mainly with the botanical classification of the wheat species, and gives an account of the various characters which may be used for classifying varieties into classes and types, such as colour of chaff, presence or absence of beard, and colour of grain. Special consideration has been given to ascertaining the variability of such agricultural characters, as height of straw, stooling capacity, and season of ripening. In order to gather reliable information on this subject, experiments were conducted with specially selected seed, which was grown at the experimental farms in the different States, and the agricultural characters were then carefully compared. The State Agricultural Departments very cordially co-operated to this end by taking accurate observations of the plants throughout their growth. The eighty-two varieties which are minutely described and classified, include all varieties which at the present time are of any known value in the Commonwealth. They represent a collection, not only of the varieties known in every State, but also of those which have become popular in certain districts only. In order to make the bulletin of especial value to the practical man, as well as to the plant breeder, an effort has been made to gather all the reliable information possible on the more practical points in regard to each variety, such as amount of foliage, height and coarseness of straw, disease resistance, districts in which a variety is popular, and other points of importance to the farmer. The bulletin contains photographs illustrating characters of assistance in identifying varieties. On application to the Institute copies will be supplied to inquirers.

THE QUEENSLAND DAIRYING INDUSTRY.

A YEAR'S REVIEW.

By E. GRAHAM, Director of Dairying and Cold Storage.

The following review of the dairying industry in Queensland is taken from the Annual Report of the Under Secretary for Agriculture and Stock (Mr. Ernest G. E. Scriven) to the Minister (Hon. W. N. Gillies) for presentation to Parliament:—

Generally the season was not conducive to high production of dairy products; the volume of the rainfall in the most favoured dairy districts was below average, and in many localities droughty weather conditions prevailed practically throughout the year. Milk production and succulent pastures and fodders for dairy stock are so closely allied that it is natural for adverse weather conditions to be reflected in the quantity of the milk yield, which may usually be taken as an index to the state of prosperity of the industry as a whole.

Applying this rule, we find that the milk production for the year 1921 is recorded as being 151,000,000 gallons, and that for the past year is given as 134,000,000 gallons, a decrease of 17,000,000 gallons of milk within the latter year. The milk raised was utilised for domestic purposes or used in connection with the manufacture of butter, cheese, or condensed milk. By far the greater proportion of the total of milk produced was used for the purpose of manufacture into butter, and under this heading there was absorbed about 77 per cent. of the total quantity of the milk raised upon the dairy farms; consequently the manufacture of butter is to be regarded as the most important and principal branch of dairy activity in this State—a position which has been maintained for many years past.

The particulars supplied hereunder show the disposition of the milk under the various headings, together with the quantities of milk used for similar purposes during the former year.

Milk used for Domestic Purposes.

Year.	Quantity (gallons).
1921	4,569,640
1922	5,061,957
Increase	492,317

Milk used by Cheese Factories.

Year.	Quantity (gallons).
1921	13,264,810
1922	9,764,933
Decrease	3,499,877

Milk used at Condensed Milk Factories.

Year.	Quantity (gallons).
1921	3,985,979
1922	2,700,788
Decrease	1,285,191

Milk Separated for Butter-making Purposes.

Year.	Quantity (gallons).
1921	117,411,706
1922	104,949,114
Decrease	12,462,592

In a comparative sense the people of Queensland are not heavy consumers of fresh milk, but on the other hand a considerable quantity of condensed or dried milk is taken into consumption. An increase in the consumption of fresh milk by approximately half-a-million gallons within the year may possibly be taken as an indication of a growing taste being cultivated for the commodity in a fresh form. Neither the producers nor vendors of milk have attempted an effective canvass or campaign with

the specific objective of increasing the sale of milk to householders, caterers, &c.; and this may, in a measure, account for the lower figures of consumption that prevail here as compared with those of other countries where milk is more freely partaken of.

From a health point of view, there is no satisfactory substitute for milk to be suggested, and, all things considered, milk ranks amongst the cheapest of foodstuffs offering at present.

It is interesting to note that the consumption of butter and cheese has attained a high level, and in proportion to their number, the inhabitants of Queensland consume more than ordinary quantities of butter and cheese, and the assumption is that the more general use of milk within the household could be brought into practice. To this end fuller publicity, on the part of those engaged in the marketing of milk, of the many advantages which the use of milk has to commend it would, no doubt, be helpful. The industry in other countries has gained materially as a result of action taken on the lines indicated.

At the termination of the year there were 21,931 dairying establishments in existence, an increase of 236 in number over the figure (21,695) recorded for the former year. Included in the category of dairying establishments are 48 butter factories, as against 47 for the former year; 79 cheese factories, which number is 4 less than were in operation for the former year; and 3 condensed-milk factories, a comparative increase of one factory over the former year. The balance of the number, viz., 21,802, required to make up the total complement given as dairy establishments, comprised principally dairy premises utilised by dairy farmers in connection with the industry on their farms.

Irrespective of the adverse nature of the season, an additional number of landholders elected to engage in dairy farming, and the number so doing would have been appreciably higher if the weather conditions had been more encouraging and offered greater promise of success. At present there are rather more than 500,000 cows utilised in the dairy herds. The industry has been developed and advanced to a stage which makes it reasonably safe to predict that under normal seasonal conditions Queensland will rank foremost amongst the States of the Commonwealth in the amounts of butter and cheese that will be available for exportation overseas from year to year. In the year 1921 this State attained the distinction of being the principal individual contributor of the Federation in the quantities of both butter and cheese consigned to overseas markets. The subsequent dry season robbed her of pride of place in respect to the volume of butter exported, but the premier position in regard to cheese exportation has been retained continuously for many years past.

Little more than a quarter of a century ago the production of butter was about equal to the local requirements, and the marked expansion of the industry that has taken place within a comparatively short space of time betokens the future possibilities of dairying in this State. To date only a proportionately small percentage of the land which is suitable for dairy purposes has been brought into requisition. In the immediate future it is likely that a comparatively large acreage of land will be made available for closer settlement in the Burnett district and elsewhere, and the probability is that dairying will be the principal industry engaged upon in these areas, and the importance of the industry as a whole will be added to accordingly.

Butter.

Referring more specifically to the production and manufacture of butter, it is found that the quantity of butter manufactured during the calendar year 1922 is returned as being 53¾ million lb., a decrease of 7 million lb. as compared with the production of butter for the former year. The butter was disposed of through the avenues of the local, overseas, and interstate markets. A general uplift in the standard of quality was effected within the year, and a considerable increase was made in the percentage of higher grades of butter manufactured, as compared with other years.

The consignments of butter from individual factories were, upon arrival in Brisbane, carefully examined by officers of the Dairy Branch, and defects in the quality of the butters were noted by them. In turn the factory responsible for the manufacture of butter in which faults were detected was advised accordingly; and in instances where it was considered necessary an officer was despatched to the factory for the purpose of conveying instruction with a view of obviating the defects in the product.

The application of the principle of neutralisation and pasteurisation of cream preparatory to churning into butter has been practised more generally by butter manufacturers. The results have been satisfactory, and have led to improvement in the keeping properties of the butter produced from the treated cream. The pasteurisation of cream has proved of special benefit to those factories which engage in the

export trade in butter with overseas countries, for to reach these distant markets the butter must necessarily be retained for a considerable time in cold chambers under refrigeration prior to arrival at its ultimate destination. In this way the butter is allowed ample opportunity for deterioration in quality to take place, and this undesirable change in quality is not to be arrested or prevented to any full degree unless the process of pasteurisation of the cream is carried out efficiently, and strict attention is given to every detail connected with the process of manufacture.

In the butters coming forward for inspection from time to time, there has been detected greater freedom from alkaline or cooked flavours and in this there is provided the best of evidence that the processes of neutralisation and pasteurisation of the cream are being carried out with greater skill and care at the factories than was the case formerly. The causes to which these particular defects are attributable have been fully explained to manufacturers, together with the means whereby the presence of these faults in butter are to be obviated.

After passing through a period of almost absolute freedom from wood-taint in butter, a complaint has been made to the effect that wood-taint flavour was discernible in some of the butter supplied to a Southern State this season. The butter absorbs the characteristic flavour known as "wood-taint" from the timber used in the making of the butter-box into which the butter later is packed. As a general rule, not more than an appreciably small percentage of the total butter in a consignment is affected by wood-taint, but under certain conditions of the market the presence of wood-taint, even if the fault is restricted to a small proportion of the butter output of a single factory, may prove disastrous; and because of this happening, it is necessary that the wood-taint flavour must be overcome without delay.

The investigations made into the underlying cause of the trouble go to show that the use of unseasoned timber, or the utilisation of top-sections of tree trunks, or logs affected with what is known to sawmillers as "black heart," is to be discountenanced for box-making purposes.

It was also discovered that in practice it frequently occurs that the taint is limited to one of the sides or to a single piece of the timber used in the making of the butter-box, and the damage to the quality of the butter, although restricted to that portion of it which was brought in contract with the tainted timber, was sufficient to disqualify the butter from being awarded a high-grade classification.

The difficulty is, too, that the person making up the boxes is unable by casual observation to discriminate readily between the timber which is free from taint and that which is affected with it; consequently there is a possibility that in the making up of a box a piece of timber may be utilised that is unsuited for that purpose.

The species of pine from which box timber is procured are those known as white pine (*Araucaria Cunninghamii*) and the bunya pine (*Araucaria Bidwilli*), the former being most generally employed. A number of analyses of the timber from which the boxes are made has been carried out from time to time by the Agricultural Chemist (Mr. J. C. Brünnich), and the results go to show that generally the timber is comparatively free from resinous matter liable to exert tainting influences upon butter packed in boxes made from it; consequently the cause of wood-taint becomes restricted to variance in the stage or nature of the growth of the trees, or the methods adopted in the seasoning of the timber prior to its use for box-making purposes.

The concerted efforts of those controlling sawmills or butter factories should be centred upon the eradication of wood-taint; and, as the interests of both parties are liable to suffer by a continuance of the fault, it is not anticipated that there will be any difficulty in gaining their co-operation in the direction of keeping our butters free from the defect.

It is particularly in connection with the interstate trade in butter that wood-taint has been brought into evidence; and it is somewhat remarkable that the presence of wood-taint flavour has not been commented upon in butters disposed of in the oversea markets, as it is through the latter channels that most of our butters are sold.

Although investigation of the manner in which wood-taint may be conveyed to butter, and the means whereby it may be prevented, is now in training, the earlier investigations which were carried out in connection with this matter go to show that the paraffining of the timber of the box that comes into close contact with the butter is the most effectual means of obviating the wood-taint flavour being imparted to the butter.

The signal success achieved by Queensland exhibitors in the classes for butter at the Islington Dairy Show held within the year, clearly demonstrates that in the matter of quality the best of our butters do not suffer by comparison with the finest butters produced in other parts of the British Empire. The competition in butter was open to factories within the Empire, and butters from Canada, New Zealand,

South Africa, Victoria, New South Wales, South Australia, and Queensland were exhibited.

The competition was under two headings, and awards were given for both salted and unsalted butters. The prizes ranged from first to third in each class, and the butters contributed by the factories operating in this State were awarded four of the six prizes which were on offer. It is the first occasion in the history of the Islington Dairy Show that the honours have so fully been secured by the exhibitors from an individual State, and the manufacturers here are to be congratulated accordingly. The maximum points were allocated by the judges of the butters to an exhibit manufactured and submitted by a Queensland company. It may reasonably be expected that the competing butters would be thoroughly examined and subjected to the closest scrutiny by the judge, and perusal of his remarks does not disclose that wood-taint was detected by him in any of the butters of Queensland origin.

A feature of the trade in dairy produce was the unsettled condition of the markets which prevailed from time to time throughout the year. The oversea quotations were comparatively satisfactory to producers until New Year was reached, but immediately the New Year opened the overseas market for dairy produce suddenly collapsed, and, with production at a fairly high level in Australia, the market here quickly declined in sympathy, and locally dairy produce was reduced appreciably in value. A strenuous effort was made to stabilise the market throughout Australia, and a degree of success was attained in that direction. The task was one bristling with difficulties, many of which required the earnest co-operation of the producers in the respective States before a satisfactory solution could be hoped for, and as concerted action extending over such a large territory and diversity of interests was not to be readily achieved, it was consequently found that the scheme for stabilisation did not in practice accomplish all that the designers of the scheme had expected from it.

It was not that the scheme was too idealistic that a greater measure of success was not attained, but rather because the organisation was not rendered perfect in all respects. On the whole the producers benefited considerably as a result of the scheme, and the advantages would have been more decisively in the producers' favour had it not happened that New Zealand, at the end of the export season, had on hand abnormally heavy stocks of butter. Owing to the collapse of the London market another outlet was sought for the surplus, and the opportunity was taken by the sellers of butter in the Dominion to unload a considerable amount on the Australian market where values were more attractive. Naturally the intake of this butter influenced the market here, and led to a reduction in values locally. The existing reciprocal tariff arrangements operated very distinctly against the interests of producers here throughout the whole of the transaction.

Cheese.

The production of cheese was reduced in volume as a result of the adverse weather conditions which prevailed during the year. The quantity of cheese manufactured within the year was slightly in excess of 10,500,000 lb., this amount being approximately 4,500,000 lb. less than that manufactured during the preceding twelve months.

A general improvement in the standard of quality has been effected, and closer attention has been given to the preparation and packing of cheese for export. Factories have contributed a relatively larger proportion of large cheeses (80 lb.), which is the size most suited to fill the requirements of the export trade, and have adopted a crate of uniform design which materially adds to the appearance of the consignments of the cheese when presented for exportation from time to time. It is the custom to pack two cheeses in a crate.

Despite the unsatisfactory nature of the season and the consequent shrinkage in the volume of cheese manufactured within the year, this State has been able to maintain the distinction of being the principal contributor of cheese to the overseas market from Australian sources.

There has been some extension of the number of factories which have adopted the practice of pasteurisation of the milk utilised for cheese-making purposes, and without doubt the pasteurisation of the milk has proved efficacious in bringing about an improvement in the standard of quality in the cheese output of the factories which have adopted that method of treatment of the milk.

A considerable amount of interest is being taken in the pasteurisation of milk at cheese factories, and the results are being closely watched by those controlling companies wherein cheese is manufactured without the subjection of the milk to pasteurisation; and should it so happen that the pasteurisation of milk is found to be economically advantageous, there is little doubt that the utilisation of pasteurers would become more general throughout the cheese factories. It is somewhat remark-

able that, although the cheeses made from pasteurised milk are of comparatively superior quality, there appears to be no monetary advantage gained on this score from sales effected in the overseas markets, and in some instances the realisations of cheese made from unpasteurised milk have been higher than those returned for the pasteurised product. Needless to add, the cost of manufacture of cheese is increased by the adoption of pasteurisation, and unless dairy companies are assured of reasonable prospects of being recouped for the cost involved in the installation and operation of the pasteurising plant, it is unlikely that the additional outlay of capital will be undertaken.

It has always been contended that quality counts, especially when applied to any foodstuff, and the assumption is, that in the immediate future, first-quality cheese made from pasteurised milk will command a higher price in the market than will be obtained by the sale of relatively lower grades of cheese made from milk in the ordinary manner. The difference shown in the prices realised by the sale of cheeses manufactured under the respective methods is being made by dairy companies the crucial point upon which the adoption or otherwise of the pasturisation of milk for cheese-making purposes is to be decided.

Of recent years, factory managers, in order to obtain a first-class classification for their make of cheese, have been encouraged or practically compelled to manufacture cheese with a very firm body. A degree of firmness in the body of the cheese verging upon hardness, has been insisted upon. The popular taste in Great Britain is for cheese of rather soft body and even texture, and the tendency has been for oversea consumers to cultivate a preference for cheeses that are softer and softer in body each year.

In the supply of dairy produce to a conservative market, such as that of Great Britain undoubtedly is, it is a fallacy to do otherwise than to supply a commodity which is in conformity with the consumer's ideals. It is natural that a purchaser of cheese will be prepared to pay a relatively higher figure for the article which meets with his ideas of perfection, than he will pay for cheese which does not appeal to him.

A certain degree of firmness of body in cheese is necessary in order to give the cheese the requisite stability to withstand the stress of transit to market, but beyond that degree of firmness we should not go until such time as there are indications that the consumer has altered his taste in this particular respect.

General.

Throughout the year there has been a healthy demand from factories for the services of instructors, for the purpose of assisting manufacturers in overcoming difficulties that from time to time occur from unapparent causes in the manufacture of dairy produce. The evidence is that manufacturers are now more alive to the wisdom of promptly advising officers of the Dairy Branch of the difficulties experienced in factories, so that the troubles might be investigated, and the necessary remedial measures applied without delay, rather than to allow of a tolerance of the troubles in the hope that they would disappear or become modified in intensity by the lapse of time.

In connection with the investigation and solution of some of the more obscure matters with which manufacturers were confronted, the aid of both the Agricultural Chemist (Mr. J. C. Brünnich) and the Government Bacteriologist (Mr. J. C. Pound) was availed of.

The Cold Store at Hamilton, which is being erected by the Government, is nearing completion. In its finished condition the Cold Store will rank amongst the largest and most replete premises of the kind situated in the Southern Hemisphere. The Cold Store has been designed principally for the purpose of holding under refrigeration the perishable products from the dairy factories, orchards, or farms, such as butter, cheese, fruit, or eggs.

The temperature in one series of insulated chambers will be controlled by cold air circulation method, and in the remaining rooms the required temperature will be maintained by means of direct ammonia-expansion coils. The capacity of the stores will be equal to containing the produce coming forward for cold storage in a bountiful season.

Within the year a considerable number of cows which are entered in the herd-books pertaining to the various distinctive breeds of dairy stock were tested for butter-fat production. Some animals put up splendid records in face of the adverse weather conditions that maintained practically throughout the year. This State can now claim having animals with official records of production practically on all-fours with the highest listed in any country. The stud masters and owners are to be congratulated upon the enthusiasm and skill they have displayed in connection with the feeding and caring for the animals submitted for testing.

With a view of obtaining practically world-wide uniformity in the method of estimating production records of animals submitted to an official test, all production records compiled by this office will in future be expressed in the terms of butter-fat, and not commercial butter as formerly was the case.

Increased interest has been taken by dairy farmers in the submission to testing the ordinary dairy cows owned by them. Given a more favourable season an exceptionally large number of dairy cows would have been placed under test. Beneficial results, both to dairymen individually and the industry generally, must accrue from the systematic testing of the herds, and the wider the field of operations of the herd-tester the greater the benefits which will be derived from the work. Herd-testing has, as one of its objectives, the building up of a dairy herd for Queensland.

More than 560,000 dairy cows are utilised in the dairy industry at present; consequently the task is one of magnitude, and one which will be accomplished at a slower rate than would be necessary for adoption by the individual dairy farmer, who possibly would not be concerned in the uplift in production of more than the cows comprised in a single herd, say, 100 in number.

The testing of dairy herds by departmental officers has been in operation for some years, and it is very evident that the testing of the herds is bearing fruit. A comparison of the milk yield per capita of dairy cows for the years 1912-13 and 1922-23 shows that an increase in milk yield equivalent to 7½ per cent. has taken place in favour of the latter year, and no doubt herd-testing was the principal factor contributing to this pleasing result. Certainly advantage in seasonal conditions was not responsible for the higher yield of milk in the year 1922-3. In reality the rainfall for the year 1912-13 was greater than that of 1922-3.

The significance of a 7½ per cent. increase in the milk yield may be illustrated in the following manner:—The aggregate monetary value of the industry is approximately £5,000,000 per annum, and 7½ per cent. upon that amount equals £375,000 for the twelve months. Assuming that herd-testing is responsible for not more than half the increase which has taken place in the average milk yield, we find that even then there is an amount of £187,500 remaining to the credit of herd-testing.

HERD-TESTING.

Appended are particulars taken from the reports of the official Herd Tester (Mr. L. Andersen), wherein general reference is made to the matter of herd-testing, and there are given in summarised form the test results:—

"Generally speaking, the season just ended has been one of the worst experienced in Queensland for many years, and the dairy farmers in nearly every district suffered more or less, even the North Coast, which is generally favoured with a good rainfall, has suffered very severe losses.

"These losses are, in many instances, due to overstocking, which in turn is the result of the very high prices for stock that prevailed a couple of years ago; when the prices of meat dropped, the small farmers were left with too many stock and the holdings have not had an opportunity to recover since.

"During the early part of the year a few centres were visited on the Darling Downs, the principal of which were Burton, Koondai-i, Sunnyvale, and later in the year Kingsthorpe, but as the season gradually grey worse operations completely ceased in this part of the State, with the result that 61 herds only were submitted and 1,380 cows tested.

"In West Moreton a few enthusiastic dairymen kept the testing going fairly regularly, at Rosewood, Lanefield, and Haigslea, the total being 92 herds and 2,107 cows. Early in the new year the conditions were somewhat relieved by storms and light general rain in the coastal district, with the result that a good many inquiries came in from the districts along the North Coast Line and the Burnett districts. Taking the North Coast districts from Brisbane to Mount Larcom, 150 herds were submitted, comprising 3,919 cows, while in the Burnett 73 herds were submitted and 1,726 cows tested. The grand total for the season, 376 herds with a total of 9,132 cows, is a record number, and, when due allowance is made for the season, seems to indicate that the dairy farmers of Queensland are at last waking up to the fact that progress can only be attained by testing, culling, and breeding from pure-bred sires.

"The general average production of milk and commercial butter is the lowest recorded for many years, being 13·5 lb. milk and ·66 lb. commercial butter daily. The average content of butter-fat of 4·2 per cent. is slightly higher than that of former years.

"The highest average production for a herd was recorded as 1·40 lb. commercial butter per diem. This splendid yield was obtained from a mixed herd, comprising chiefly grade animals and including also six Illawarra Milking Shorthorn heifers.

"The above returns were taken during the last few days before the breaking of the drought early in June.

"The owner of this herd is the proud possessor of a silo, and in addition to ensilage he was also feeding lucerne hay, supplemented by bran and pollard.

"Strange to say, at the same centre and at the same date was also recorded the lowest daily average for a herd, viz.: ·17 lb. commercial butter, and this, I think, shows a wonderful object lesson in good and indifferent feeding.

"Unfortunately the silos are still very few in this State, but it is to be hoped that the farmers will realise that, at least to a grat extent, the silo will help to solve their troubles. In comparing the best herd with the poorest, some interesting figures are obtained. Assuming that the drought conditions extended over a period of three months and that each herd contained 50 cows, the well-fed herd would produce for that period approximately 6,300 lb. of butter, against a return of 765 lb. from the poorer herd. Taken at 1s. 6d. per lb. the returns for the period would show respectively £472 10s. and £57 7s. 6d.

"Great improvements are noted during the last couple of years in the direction of breeding from pure-bred sires from high producing stock, and the indications are that a few years hence the scrub bull will be a thing of the past.

"During the year a change was made in taking the samples of milk on the farms. Hitherto the sampling was extended over a period of seven days; this has now been altered to four days, a change much appreciated by the dairymen.

"A fair amount of time has been given during the year to instructing farmers in the practice of milk and cream testing, and this has in all instances been much appreciated.

"A large number of skim-milk samples has also been treated, showing in some cases big losses in the process of skimming.

"Appended will be found particulars of testing which has been carried out during the year."

HERD-TESTING, 1922-3.

Summary of Year's Operations.

Number of herds tested	376
Number of cows tested	9,132
Daily yield of milk in tested herds—	
Mean	13·5 lb.
Highest	25·4 lb.
Lowest	2·9 lb.
Butter-fat content of herd milk—	
Mean	4·2 %
Highest	6·0 %
Lowest	3·2 %
Daily amount of commercial butter produced in herd—	
Mean	·66 lb.
Highest	1·40 lb.
Lowest	·17 lb.
Amount of milk yielded by individual cow daily—	
Highest	44·0 lb.
Lowest	1·0 lb.
Amount of commercial butter yielded by individual cow daily—	
Highest	2·08 lb.
Lowest	·04 lb.
Butter-fat content recorded—	
Highest	9·4 %
Lowest	2·4 %

HERD-TESTING, 1922-3.

Districts.

District.	Month.	Number of Herds Tested.	Number of Cows Tested.	Average Daily Production of Milk.	Average Percentage of Fat.	Average Daily Production of Commercial Butter.
	1922.			Lb.		Lb.
Burton ..	July ..	5	112	16·5	4·4	·85
Rosewood ..	August ..	8	151	15·5	3·9	·70
Koondaii ..	September	8	183	16·7	3·8	·74
Sunnyvale ..	October	11	219	17·6	3·8	·78
Burton ..	October	4	130	23·0	4·0	1·07
Koondaii ..	November	9	223	17·1	3·8	·76
Rosewood ..	November	9	179	13·5	3·6	·56
Cooroy ..	November	9	238	8·5	3·6	·35
	1923.					
Lanefield ..	January	12	335	17·3	3·9	·79
Rosewood ..	January	12	262	17·7	4·0	·82
Cooroy ..	January	16	461	14·4	4·0	·67
Haigslea ..	February	17	376	13·8	4·1	·65
Koondaii ..	February	7	184	15·0	3·8	·67
Sunnyvale ..	February	8	175	13·0	4·1	·62
Mount Larcom	February	15	355	12·3	3·9	·56
Green's Creek	February	20	694	15·5	4·0	·72
Coalstoun Lakes	March ..	9	226	14·2	3·7	·61
Byrnestown ..	March ..	13	299	16·2	4·1	·78
Kingsthorpe ..	March ..	9	154	14·0	4·6	·75
Rosewood ..	March ..	3	111	14·7	4·0	·68
Lanefield ..	March ..	12	339	14·0	4·2	·69
Theebine ..	March ..	16	366	13·5	3·9	·61
Speedwell ..	March ..	14	274	10·5	4·2	·51
Merlwood ..	April ..	7	170	12·0	4·4	·62
Degilbo ..	April ..	6	122	10·0	4·5	·53
Glenwood ..	April ..	13	309	8·7	4·6	·47
Haigslea ..	April ..	10	204	12·7	4·5	·66
Cooroy ..	April ..	8	244	9·3	4·6	·49
Windera Creek	May ..	9	235	10·0	4·5	·54
Tiaro	May ..	9	163	10·0	4·7	·55
Mount Larcom	May ..	19	375	11·4	4·4	·58
Coalstoun Lakes	June ..	15	400	13·6	4·4	·70
Lanefield ..	June ..	9	150	12·4	4·5	·65
Cooroy ..	June ..	17	492	9·9	4·5	·52
Green's Creek	June ..	7	210	11·3	4·5	·60
Burderim ..	June ..	1	12	11·0	4·4	·56
Total Number of Herds	..	376				
Total Number of Cows	..	..	9,132			
General Average Daily Production	..	..	..	13·5	4·2	·66

Fodder Conservation.

It is not to be claimed that a comprehensive scheme of fodder conservation has been brought into practice, and unless this is accomplished the dairy industry must remain at the mercy of the seasons. During every drought there is emphasised the need that exists for the conservation of ample supplies of fodder, to maintain the dairy herds and keep the industry on an even keel.

A prolonged dry spell affects the dairy farmer proportionately to its duration. Firstly it causes diminution in the monetary returns from the sale of milk or cream, the second stage being the loss of dairy stock, finally culminating in privation or ruination to the dairy farmer. A reduction in the monetary value of the industry of from £1,000,000 to £2,000,000 is not unknown, exclusive of the value of the dairy stock which dies of starvation.

Many of our dairy farmers hold the opinion that it is an expensive undertaking to grow and conserve fodder and eventually feed it to dairy stock. To a degree their opinion is not unfounded, but obviously it is a doubly costly practice to allow the ravages of a drought to play havoc unmolested amongst our dairy herds. The advances by loan under the Co-operative Agricultural Production and Advances to Farmers Act have been increased with a view of encouraging individual dairy farmers to engage more seriously in fodder conservation upon the farms.

Droughts invade our country at certain intervals, but they do not occur with the same regularity and persistency as bleak winters and heavy snowfalls do in other parts of the world where dairying is engaged in on an extensive scale. Both housing and hand-feeding of dairy stock are necessary in the colder countries in order to win through. There the battle has to be fought each year, and the fight extends over six or more months in some countries. Our task is to combat the influence of drought recurring at intervals of probably from three or possibly seven years, and in doing so the silo or hayshed, filled with fodder, will be found amongst the most effective weapons, and they are armaments which, under normal seasons, most dairy farmers are in a position to provide, if they so willed.

The alternative to the storage of adequate supplies of fodder on the farm is to make fodder conservation a national matter.

THE DAIRY HERD, QUEENSLAND AGRICULTURAL COLLEGE, GATTON.

MILKING RECORDS FOR NOVEMBER, 1923.

Name of Cow.	Breed.	Date of Calving.	Total Milk.	Test.	Commercial Butter.	Remarks.
			Lb.	%	Lb.	
Netherton Belle	Ayrshire	30 Oct., 1923	806	4·0	37·51	
College Cobalt ..	Jersey ..	14 Sept., 1923	690	3·8	30·90	
College Grandeur	,,	11 July, 1923	480	5·1	28·80	
Miss Betty ..	,,	30 Oct., 1923	682	3·6	28·52	
Hedges Madge ..	Friesian	18 Aug., 1923	720	3·3	27·60	
College Wildflower	Jersey ..	13 Aug., 1923	570	4·1	27·30	
Magnet's Leda ..	,,	18 Aug., 1923	540	4·3	27·00	
College Cold Iron	,,	23 April, 1923	480	4·8	27·00	
Bellona	Ayrshire	3 Aug., 1923	540	4·3	27·00	
College Promise	Jersey ..	14 Aug., 1923	480	4·7	26·40	
Dear Lassie ..	Ayrshire	1 Nov., 1923	510	4·4	26·10	
Miss Security ..	,,	8 June, 1923	600	3·7	25·80	
Buttercup ..	Shorthorn	7 Sept., 1923	720	3·1	25·80	
Prim	Friesian	4 April, 1923	720	3·1	25·80	
Comedienne ..	Jersey ..	10 July, 1923	450	4·8	25·20	
College Evening Glow	,,	5 April, 1923	420	5·1	25·20	
Lady Loch II. ..	Ayrshire	26 April, 1923	540	3·8	24·00	
Confidante ..	,,	7 Sept., 1923	540	3·7	23·40	
Lute	,,	26 April, 1923	510	3·9	23·40	
Lady Meg ..	,,	14 July, 1923	510	3·9	23·40	
College Hope ..	Jersey ..	21 Oct., 1923	480	4·0	22·20	
College St. Martha	,, ..	25 June, 1923	360	5·2	21·90	
Songstress ..	Ayrshire	22 Aug., 1923	480	3·9	21·90	
Snowflake ..	Shorthorn	17 May, 1923	480	3·9	21·90	
Gay Lassie ..	Ayrshire	5 July, 1923	420	4·4	21·60	
Yarraview Snowdrop	Guernsey	7 Sept., 1923	450	4·1	21·60	
College Prima Donna	Friesian	19 Mar., 1923	480	3·7	20·70	
Dawn of Warragaburra	Jersey ..	10 Nov., 1923	399	4·4	20·58	
College Desire ..	Ayrshire	11 July, 1923	420	4·1	20·10	

CANE PEST COMBAT AND CONTROL.

Mr. Edmund Jarvis, Entomologist to the Bureau of Sugar Experiment Stations reports (27th December, 1923) to the Director (Mr. H. T. Easterby), as under:—

White Ants Attacking Cane.

Our earliest record with regard to cane being affected by termites was published in 1916, in Bulletin No. 3 of this office, the two species implicated being *Termes meridionalis* and *Eutermes fumigatus*, neither of which, however, effect serious damage to this crop.

Both species attack the young cane; *meridionalis* being held responsible at times for quite a number of misses in rows growing close to headlands.

Fortunately, such injuries are confined almost exclusively to the sets, although exceptional cases have occurred at Meringa where this termite, during drought conditions, has been discovered tunnelling in cane-sticks. Similar damage has been reported from Mossman, caused probably by a species of white ant not found in the Cairns district.

In the Giant Termite (*Mastotermes darwiniensis* Frogg.), however, we have a truly formidable cane pest, which around Ayr and on the Lower Burdekin, is fast becoming of decided economic importance. The nature of injury caused by this species was reported by the present writer about nine months ago (*see* "Queensland Agricultural Journal," vol. XIX., p. 372), and since that date preliminary experiments have been carried out here along various lines of control, with a view to combating its ravages.

These remedial methods fall under three main headings, viz.:—

(1) Fumigation of the ground;

(2) Poison baits;

(3) Protection and introduction of natural enemies.

With regard to the first of these control methods, the best time to commence such work is when the young plant cane and ratoons are quite small, as at this stage of plant growth the termites will probably not have got into the stalk, but be either entering the sets or congregating around them, prior to taking up their quarters therein, so that at such times the fumes from carbon-bisulphide or para-dichlor., &c., would easily reach them.

The latter fumigant would doubtless be more effective than carbon-bisulphide, as the fumes given off from ½ oz. of para-dichlor. would operate for at least four weeks, thus having ample time to impregnate the ground and penetrate into any unsealed holes in the sets or underground portions of canes.

In the event of specimens having already bored into the sets, the odour from the fumigant should be able to reach these invaders, provided that the tunnels by which entry had been effected had not been closely plugged up afterwards by the termites.

Injections of para-dichlor. should be placed 1 foot apart on each side of a row of cane stools, about 6 inches from the centre of stools, and at a depth which would come just above the level of the sets. This fumigant is insoluble in water, easy to handle, non-poisonous, not inflammable, and the fumes are not in any way objectionable.

With reference to poison baits, Mr. W. Payard, of Brandon, has found that arsenic mixed with molasses and sprinkled around the nets of this termite proved very effective. This treatment would be worth a trial in places where such infestation happens to be confined to small areas, and could be easily applied on various media, the most suitable of which, however, have yet to be determined by future experimentation. The medium used should be cheap, easily obtainable, and preferably of a manurial nature.

Experiments conducted here some months ago showed that dipping the sets in a solution of Paris green ½ oz., water 2½ pints, gave a mortality of 100 per cent. after four days. The small pieces of split cane used in this test were merely dipped in this solution and laid on top of the soil in cages containing specimens of *Mastotermes darwiniensis*; which, during the night, came out of the earth and fed on the poison bait. Apparently, judging by Mr. Payard's experiment, this would happen also under field conditions, as after feeding on the arsenic and molasses applied by him at Brandon, a great many of these white ants must have died on the surface of the ground; a quantity, he tells us, sufficient to have filled a couple of flour bags.

Emergence of Cockchafer Beetles.

A welcome shower of rain (0·18 inch), heralding the break up of drought conditions, fell here on 6th December, and was at once followed by an emergence of several species of small melolonthid beetles belonging to such genera as *Heteronyx, Liparethus,* &c., but proved insufficient to stimulate the subterranean activity of our greyback and other related cane-beetles. Additional rain (0·98 inch), registered forty-eight hours later, enabled *Anomala australasiæ* to appear on the wing, numbers of these bronze-green beetles being observed flying around papaws and other plants.

Up to 10th December, however, no general emergence of *albohirtum* had occurred here, although at Highleigh, where the precipitation had been heavier (1·59 inches), many greybacks were noticed on their feeding-trees. Emergence commenced at Meringa on 13th December, when the rainfall during the preceding week had attained a total of 3·51 inches.

Although unable at present to gauge the numerical strength of this formidable cane-pest, it may be of interest to mention that from data obtained at the beginning of December it appears that grubs are likely to do considerable damage to cane next season; but that, owing to the natural check on their increase which took place last year, the average infestation during February to April, 1924, will probably be below that experienced during normal seasons.

Control of Cane-beetles.

Experiments are under way at present for testing the effect of various poisons on the grey-back cockchafer.

Results obtained by the writer during past years have shown that both lead and copper arsenates, if sprayed on the foliage of food-plants in cages, will kill all beetles chancing to eat a small portion of such poisoned leafage in from eight to ten days.

Experiments this season will test the value of various dust sprays, &c., which, in field practice, are more easily applied than liquid solutions, and it is hoped may act more rapidly.

Such dusting of favourite fig-trees growing near canefields or planted for this purpose on headlands, might tend to considerably reduce the numbers of beetles attracted to them; and would act also as traps, that while constantly operative would need little or no attention.

Another interesting phase of control which will be continued during this season is that of attempting to capture adults of *albohirtum* by the use of aromas resembling those which may be presumed to normally exercise an attractive influence either in connection with food-plants of the beetle, conditions favourable to its larval stage, or with sexual relationships.

SUGAR: FIELD REPORTS.

The Director of Sugar Experiment Stations has received the following report (21st December, 1923) from the Acting Field Assistant in the Southern Sugar districts (Mr. A. P. Gibson):—

Nambour.

The Nambour sugar areas were visited in the course of December. This is a wonderfully rich district. Here everything appeared bright and beautiful. While other Southern districts raised tonnages not equal to one-half of their possible production, Nambour, situated not many miles southward, raised a record crop. Rainfall record for 1923:— January, 599; February, 591; March, 371; April, 19·06; May, 202; June, 312; July, 471; August, 129; September, 114; October, 113; November, 554; December, 195 up to 16th December. Total, 55·57 inches.

The four principal mill supply areas are—

(1) Petrie's Creek.—A long, narrow strip of land bounded on two sides by wooded upland. This fertile valley is composed of soil washed from the sidelands, and is drained by the creek from which it derives its name.

(2) Maroochy River, and (3) Yandina areas, are mostly rich alluvial deposits, which like Petrie's Creek raise good crops of satisfactory sugar content. Portions of these districts are subject to flooding and frosts.

(4) Dulong is highly situated; the nature of the country being mostly volcanic. Farmers have combined cane-growing with fruit or dairying. The transportation of the crop from these parts is interesting—a 2-feet tram line, possessing many sharp

curves, contours the steep range, and the cane trucks are drawn by a powerful Shay locomotive.

Practically all the cane is railed to the factory, the greater portion passing over the company's 2-feet tram line from Maroochy, but every year the quantity railed over the Government line is increasing. When the season commenced it was estimated that 48,000 tons would be crushed; this quantity it is expected will be treated this year, but the management propose continuing operations into January. It is apparent, however, that much cane that should be cut will not be crushed, and this will result in a loss to growers and the district. The mill has failed to crush the weekly tonnage expected, and in consequence growers and harvesters have been greatly inconvenienced. January harvesting is not desired for many reasons, the principal of which are:—Reduction in sugar content, harvesting and subsequent husbandry often hindered by continuous wetness, and the fact that the crop is not sufficiently advanced for the following crushing.

The varieties of cane raised here are somewhat numerous, but in quantity not plentiful, therefore the important ones only are mentioned. D.1135 is extensively grown, and for a good all-round cane is hard to beat. H.Q. 285 (known as early maturer) is also giving satisfaction, its tonnage per acre is less than that of the D. 1135, but its commercial sugar content is higher. It is not a good standover cane, but is suitable for lowlands, because the beneficial qualities of early maturing are an advantage, although it cannot be classified as a good frost resister. Q. 813 is becoming a popular variety, and is yielding profitable crops high in sugar. M. 1900 is a real good cane, and doing well on the upland near the town of Nambour. The Goru family, N.G. 24, B. and N.G. 15, should do well on the deeper alluvial deposits.

Pests and Diseases.

The principal pests found damaging the cane here are as follows:—*Pentodon australis*, moth-borer, grubs, white ants, and army worms. The presence of the former two mentioned is indicated by dead heart in young plant and ratoons.

Pentodon australis, a black beetle about ½ inch long, noted to be more numerous on land that has carried paspalum grass. This beetle makes unsightly holes in the sets, and gnaws into the tender hearts of new shoots just above the mother plant under ground and stubble of ratoons. The same beetle was found by the writer six years ago damaging young canes at Proserpine, and this year seriously damaging plant and ratoons in the Kolan South River area. *Pentodon australis* appears to be spreading rapidly, and if not controlled is likely to cause widespread destruction in the Southern sugar areas. Moth-borer was found penetrating the heart of new shoots on ground level and causing dead heart, but is not causing serious damage.

Mosaic disease was noticed, more especially in ratoons and in a patch of varieties. Gumming is also prevalent; this is a dangerous disease, and many affected canes were seen on the loaded trucks. It is usually found on poorly drained lands, and like the Mosaic, is said to be spread by sucking insects, but may be controlled to a certain extent by planting sets free from infection.

Plant and Ratoon.

There is a big area of newly planted cane. This has germinated favourably, and was well established, and like the 1924 ratoons has been well cared for. The coming crop presented a beautiful healthy appearance, was well advanced, and looked promising for another prolific crop.

The cultivation was found to be satisfactory, the usual ratooning method being adopted—*i.e.*, ploughing away from stubble and bursting up the interspaces or levelling same by disc or tine implements. The physical and mechanical condition of the soil in places might be improved by under or surface draining, liming in conjunction with legumes, and planting cane in lands.

Manuring.

B3 mixture containing nitrogen 6 per cent., potash as chloride 8 per cent., phos. acid as bone, 8 per cent., is being applied at the rate of 6 cwt. per acre to the cane drill and lightly covered by disc cultivator. The Maroochy River line has been recently extended to the picturesque Coolum beach, distant 11 miles from Nambour. This line is built through a dense tea-tree swamp near sea level, through which many salt water creeks pass; this swamp is being drained and cleared for sugar-growing, and big things are expected from it in the near future.

The land in this swamp varies from a peaty to a very dark cohesive or gluey soil. After this has been thoroughly drained and cleared it should be limed and ploughed three to four times, allowing long intervals between each ploughing, so that the soil may become aerated and pulverised.

EUCALYPTIAN FACTS.

By E. H. F. SWAIN, Director of Forests.

Eucalypts will not regenerate or develop in shade; they demand the full sunshine and are classed as intolerant, or strong light demanders; they spring up in exposed places more or less directly from the mineral subsoil; as seedlings they assert themselves immediately and gain dominance by extraordinary rapid height growth; as poles they extend in open order through the forest, and as veterans they stand in the light of everything else.

Because of their wide spacing there is ample room beneath them for other species; the shade they cast is not heavy, scarcely heavy enough indeed to oust grass, itself a fierce light demander; their litter of leaf and bark, however, tends to extinguish grass growth but produces its own antidote of bush fires which aids grass to ascendancy by disposing of the encumbering debris and by thinning the Eucalyptian canopy.

The evolution of the Eucalyptian forest from this point depends on the moisture content of the soil; if the moisture content be high the Eucalyptian tree growth is good, the shade heavier, the leaf and bark litter thicker, the subsoil gains an overlying organic soil, and the shadebearers enter; first Brush Box and Turpentine, leading up to the Hoop Pine type, or if the soil moisture is very high, Hoop Pine again is ousted by the high moisture loving species, Cryptocaryas in the South, Maple in the North.

As the moisture content of the soil falls, the underwood of the Eucalypt forest more or less disappears, the rate of growth of the Eucalypt falls off, the canopy thins; the conditions for regeneration of the Eucalypt reaches the optimum; save for moisture, which, however, may come with a succession of good seasons.

Eucalypts thus require fierce sunlight, and open spacing; they resist fire and drought, but are overcome by more tolerant species which appear beneath them as the moisture content of the soil reaches the necessary point of saturation.

Eucalyptus forests develop on or from the subsoil rather than from the soil proper; they appear to depend little upon the humus layer, and are more or less independent of soil sterilisation; in these respects they differ fundamentally from old-world forests and are outside the law of silviculture which insists on canopy and soil preservation by density of stocking.

Eucalypts are not soil improvers and appear to be contemptuous of soil improvement; if soil improving species are introduced in soils of high moisture content, the reign of the Eucalypt is in grave danger.

In soils of low moisture content the Eucalypt does not produce acre-increment to the same extent as some coniferous species, and may or perhaps should be replaced. In soils of high moisture content, the rate of growth is good, but the Eucalypt is ousted by the development of a shade-bearing underwood, which forbids further Eucalypt regeneration and eventually succeeds to the dominance of the forest, ending in Hoop Pine, Cryptocarya, or Maple forests.

Eucalypt forests belong to the regions midway between high and low soil moisture content, and between high and low soil fertility. Elsewhere they should be replaced by species better suited to get the best out of the factors of the locality.

Eucalypts fruit more or less heavily, at what intervals for different species is not determined, the fruit often adheres to the fruiting twigs for a number of years, and the fruit of one, two, or three seasons often may be seen on the same tree or branch.

The opening and spilling of the seed from the fruit may be stimulated by gales breaking off the fruiting twigs and depositing them on the ground; or by ringbarking or burning operations drying up the tree and causing the fruit to open and distribute its seed.

Young Eucalypts coppice heavily when cut down; seedlings reshoot from ground level when cut or browsed down.

The usual heavy regrowth that one sees in the Eucalyptus forests is a mixture of coppice shoots and seedlings, more often than not it is coppice; the whole is usually damaged by fire or other injury, and few good sound straight saplings will be discovered on close examination.

The forester seeks as pure seedling regrowth as may be. To attain this he must cease cutting down small trees; but if small trees are not cut down the ground usually is not open enough for seedling regeneration.

The ideal silvicultural system for Eucalypts would be entirely clear felling with subsequent production of an instant even-aged seedling regrowth of Eucalypts.

As the forest now is uneven-aged, and harvesting consists only of removing the biggest and best trees, the forester is left with an area covered with useless old trees and useful young trees; to secure seedling regeneration he must remove both, but by removing the young trees he will get coppice at the cost of sacrificing developing material, and by destroying the old trees he is left without seed trees for naturally regenerating the forest.

In the dilemma the forester compromises by selecting the most suitable openings in the forest upon which to start operations; he hopes eventually to link up these openings into a complete new forest, even-aged in groups if not even-aged for the compartment or the forest.

This silvicultural system is called "selection by groups" and offers the best compromise for securing "clear felling" and a subsequent even-aged forest on the group area.

Having seed trees adjoining the group he has the ideal condition for Eucalyptus regeneration of a clear opening (clear felling) with some certainty of a sidelong seed distribution and certainly ample assurance of coppice shoots from the destroyed trees to fill up.

To secure a crop, one must have (*a*) Seed; (*b*) a suitable seedbed; (*c*) moisture and warmth; and (*d*) light, which in the Eucalypt case must be ample.

Where the seed comes from and where the seed goes to in our hardwood bushes is often a Eucalyptian mystery; one hears of paddocks cleared and grassed for many years and then shut up during a law-suit, regenerating back to Eucalypt forest, though Eucalypt trees are miles distant. One hears of Angophora gums being ringbarked and the forest reproducing to Ironbark.

In 1910, on the Bellinger River in New South Wales, I traced seed carrying ants to their nest and dug up a pyramidal granary of bloodwood seeds. In 1917, at Benarkin, Queensland, when the Blackbutt fruiting twigs lay thickly on the ground, ants were busily engaged sinking shafts beneath them and conveying the Blackbutt seed underground; at this spot a burnt tree head had left an ash heap and it occurred to me that any seed which might fall thereon could not be "mined" by the ants whose shafts and themselves would be buried and smothered in it.

Ants and fires therefore play a large part in Eucalypt regeneration; what part, we do not yet know with sufficient precision, but the observer cannot fail to note the frequency of regrowth clumps where tree heads have been burnt.

Eucalypt seed germinates best in drifts of sand and leaf litter or soil of equivalent physical consistency; it is a mere grain of sand in size itself and accumulations of shrubbery, grass, leaves, and humas tend to keep it away from the mineral soil and successful establishment.

Bush fires, by reducing the accumulation to a level seed bed of fine tilth, not merely set out traps of ashes, but afford accommodation for successful germination.

On Fraser Island it was found that caterpillars and grasshoppers speedily swept off the cotyledonary Eucalypt seedlings in their infancy in the case of seed-spotted areas where germination had succeeded, but that where bush fires had anticipated the caterpillars and grasshoppers by immolating them, the seedlings were surviving.

This experience is repeated in Western Australia. A speaker at a recent conference of senior officers of the Forestry Department of that State said that, "on country that had been burnt over during November, December, and January, there had been really good germination of jarrah seedlings, and also on adjoining country that had been burnt. When out the other day making notes on the country and the difference in the seedlings, he found that all the seedlings on the unburnt country had practically disappeared, and they were in all stages of being eaten by insects, whereas on the burnt country adjoining very few of the seedlings had been destroyed."

Again, on another clear-felled compartment, there had been no fires whatever on it since the felling and regeneration clearing three years previously when the tops and leaves were left intact. To-day they had almost disappeared by decay, but whilst the country was now carrying 1,217 coppice shoots per acre two years old, up to 25 ft. high, *there were no seedlings whatever.* The seedlings in the last few months had been eaten by caterpillars.

The essentials of Eucalyptus regeneration therefore are—

(*a*) A clear opening of sufficient extent;

(*b*) A regeneration fire to (1) destroy caterpillars and grasshoppers which would eat the cotyledonary seedlings; (2) provide an ash-barrage against ant attack; (3) furnish a suitable level seed bed of fine tilth; (4) repress root competition from ground shrubbery; (5) eliminate soil acidity;

(*c*) Ample supplies of seed from adjoining standing trees, from ringbarked trees on the opening, or from the ground if it were true that the seed remained stored there and survived the regeneration fire or were unburdened by it of overlying litter and vegetation;

(*d*) Sufficient rainfall at the right time;

(*e*) Protection against (1) suppression by coppice shoots, or other vegetation; (2) falling limbs from the dead canopy overhead; (3) *succeeding fires.*

The question of fire protection therefore is bound up intimately with the problem of Eucalypt regeneration. Fire must be used for regeneration purposes and not afterwards. Yet fire is a natural consequence of the Eucalyptus forest conditions of dry sites and dry underwoods and dry undergrowth, open stands, and grass.

The matter of fire protection further is a matter of grazing control and we are reduced to the proposition of a Eucalyptus *cum* grass mixture, with grazing control.

Graziers insist on periodical firing for grass production; periodical fires damage Eucalypt regrowth and undo all the good that they do in the regeneration phase.

The Western Australian Department of Forestry is applying itself fruitfully to the problem and has secured very interesting results. Briefly, the system it has evolved thus far is as follows:—

(*a*) The forest is divided into logging blocks;

(*b*) The miller is awarded a logging block more or less equal to the periodic capacity of his mill, and to be cut out as thoroughly as possible before being granted a new block;

(*c*) A light fire is run through each cutting area by the Forest Department prior to felling operations by the miller. This can only be done when the weather warrants and will apply only to the area to be cut over during the current year;

(*d*) The Forest Department workmen follow the fallers and clear the debris for a distance of about three feet from around the trees and poles it is desired to protect. Limbs which stick up from the fallen trees and are likely to carry fire into the tops of adjacent trees are lopped;

(*e*) The crowns of fallen trees are burnt as soon as possible after the debris has been removed from around the trees requiring protection. The burning of the inflammable leaves and branchlets suffices.

Queensland procedure is similar. It is preferable for the Forest Service to arrange its own falling (on contract) subject to the conditions:—

(1) Forest Service controlled creeping fires to precede felling wherever such can be managed;

(2) Fallers to cut in a face within the confined limits of a block or compartment and to clear all debris 3 ft. (at least) away from useful immature growth (only) left behind; sleepergetters and girdergetters similarly;

(3) Forest Service to inspect and *complete* removal of all merchantable growth; ringbark useless trees and burn off the inflammable debris of the workings immediately after the felling.

Thereafter fire protection is vital. The fire plan will take four forms:—

(1) Fire season lookout and patrol with instant detection, location, and suppression as the objective;

(2) Fire beating from the tail pinching in the sides to the head;

(3) Fire protection propaganda and co-operation as between settler and forest officer;

(4) Fire belt burning off around regeneration areas, plus road fire-brake planning.

Eucalypt regeneration develops rapidly after establishment, the stand of seedlings is extremely dense, but thins out rapidly because of its intolerance to shade; the natural thinning should be aided by artificial thinnings in the pole stage and a very open stand of full-crowned poles developed when the underwood and undergrowth may be reduced to grass to be heavily stocked and periodically burned over by slow-creeping Forest Service controlled fires (preceded by removal of debris from around the base of desirable trees).

Forest Service endeavours in Queensland should be to produce Ironbark girders and pole trees on as large a scale possible; Red Stringybark, Tallowwood, and Blue Gum (Red Messmate and Red Irongum) are also to be sought after.

FRUIT FLY INVESTIGATIONS.

The Acting Premier (Hon. W. N. Gillies) has made available the following Report of the Entomologist at Stanthorpe, Mr. Hubert Jarvis, for the months of October and November, 1923, on his Fruit Fly Investigations and Observations of other Insect Pests:—

FRUIT FLY.

General.

A notable fact this season is the almost total absence of fruit fly in the Granite Belt District during the months of October and November.

The first fruit fly (*C. tryoni*) was caught on 30th October, the next (after the lapse of just over a month) on 2nd December; both these flies were females, and the eggs were quite undeveloped. One male specimen of *C. tryoni* was captured on 3rd December. These three fruit flies were caught in an ordinary glass bowl fly trap.

The severe winter frosts, and the abnormally dry weather prevailing during the late winter and early spring, were conditions most unfavourable to the overwintering and development of fruit flies; and these weather conditions are, no doubt, in a measure, responsible for the present absence of "fly."

The general cleaning up of packing sheds throughout the district and the safeguarding of imported fruit from living fruit fly maggots by cool storage prior to its being sent into the Granite Belt, are also measures of control which cannot have failed to exercise a beneficial effect.

Wintering of Fruit Fly.

No fruit flies have yet hatched from infested fruit, secured last autumn and placed under gauze screens and thenceforth kept under observation throughout the winter and spring, both in the field and also in the Insectary.

In some instances, such fruit was placed in a sheltered situation such as would be afforded by the average packing shed. No fruit flies have emerged to date from fruit so sheltered.

On finally examining, moreover, the fruit refuse contained in several of these experimental screens or cages, no living fruit fly maggots or pupæ have been met with, in or under it.

The above facts would seem to indicate that the fruit fly (*C. tryoni*) did not overwinter in the Granite Belt District.

Imported Bananas.

Imported and locally purchased fruit fly maggot infested bananas or mangoes, during October and November, might easily account for the presence of the few fruit flies caught this season.

In three instances have fruit flies (*C. tryoni*) been bred here in Stanthorpe from locally purchased bananas; moreover, the owner of one orchard, in which the fruit flies were captured this season, had purchased in October last a box of bananas, some of which were noticed to have been in a bad condition and were therefore thrown out (the banana being at that time considered a safe fruit in relation to fruit fly infestation).

Trapping and Luring.

Glass fly traps, baited with a lure, are now and have been for some weeks sent throughout the district, and also over the border in New South Wales. No specimens of *C. tryoni*, other than the four specimens above noticed, have been taken, although flies of other families (harmless in relation to fruit) are quite abundant and readily trapped.

The Solanum Fly.

The Solanum fly discovered by Mr. H. Tryon, Government Entomologist and Pathologist, and generally known as *C. tryoni*, var. *Solani*, is also present in the Granite Belt area, and is being trapped with lures.

Fifteen specimens of this insect have to date been examined by me and all proved to be male insects.

The presence of this fly in the orchards is noteworthy in that early peaches, plums, and apricots are now ripe and are being daily sent to the market sound and quite free form fruit fly attack, proves its harmlessness in relation to commercial fruits.

It is difficult to account for the presence of the Solanum fruit fly in the Stanthorpe orchards, since (as has been before stated) the *Solanum auriculatum*, the

fruit in which it principally breeds, has nowhere been met with within a 20 to 30-mile radius of this district; as we can also exclude the possibility of its being imported in commercial fruits, thus its migration here from warmer districts outside the Granite Belt is indicated.

Possible Immigration of *C. tryoni*.

We have yet to seriously consider the possible migration of the Queensland fruit fly (*C. tryoni*) into this district, under favourable weather conditions, and it is certainly remarkable that our worst infestations of fruit fly during the last five years, synchronise with a plentiful rainfall and prevailing easterly winds during the months of October, November, and December.

The following data for the last five years bearing on this subject (and for which I am largely indebted to Mr. J. Henderson, Instructor, and to Mr. Mowat, also of this district) may be of interest:—

Year.	Months.	Rainfall in Points.	Direction of Wind.	Fruit Fly position in Granite Belt.
1918	October, November, December	586	Easterly	Fruit Fly bad throughout district.
1919	October, November, December	270	Easterly	Fruit Fly bad throughout district.
1920	October, November, December	640	Easterly	Fruit Fly bad throughout district.
1921	October, November, December	1,272	Easterly	Fruit Fly bad throughout district.
1922	October, November, December	974	Easterly	Fruit Fly bad throughout district.

It will be interesting to ascertain wind records for years 1910 to 1918; the rainfall and information relating to the prevelence or otherwise of fruit fly during these years is already in my possession, but the required data relating to prevailing winds during the early spring of those years has not yet been secured.

The scanty rainfall and the almost continuous westerly winds have been very noticeable during October and November of the present year (1923).

It is, however, yet too early to predict a freedom from fly this season; but everything points to a light infestation.

It will, of course, be of some value should we be able to definitely predict a comparatively free season from fly or otherwise, "Forewarned is forearmed."

Fruit Shops Waste Fruit.

Every precaution is being taken to insure the destruction of waste fruit from the Stanthorpe local fruit stores. Fruit trees bearing fruit and growing in the town area are also being carefully watched.

Cold Storage.

A shorter period than the twenty-one days now stipulated would most likely be found sufficient to kill the eggs and maggots of the so-called Queensland fruit fly. Experiments in this direction would be of great value to orchardists and all concerned. (In experiments hitherto, efforts here at securing an evenly continuous low temperature that would make for this result, have failed.—H.T.)

Poison Bait Spray.

Although apparently fruit flies are absent from most orchards, experiments have been started with the arsenate of lead and molasses spray and will be continued right through the season.

OTHER INJURIOUS INSECTS.

Woolly Aphis *(Schizoneura lanigera)*.

No specimens of *Aphelinus mali* (the introduced parasite of this insect) have been to date received from those trees on which they were liberated. The last date of liberation was on 28th September (over ten weeks ago).

It is, of course, possible that specimens may yet be bred out, and to this end material from the Woolly Aphis infested trees on which the parasites were liberated has been placed in the breeding cage in the Insectary.

Codling Moth.

The Codling Moth (*Carpocapsa pomonella*) is this season very prevalent in Granite Belt orchards. The first "hatchings" (moth emergences) recorded by me were on

4th October, 1923. At this time, early apples (Lady Carrington) had finished flowering and the petals were falling.

Undoubtedly the Codling Moth can be controlled by opportune spraying properly conducted.

Unfortunately, however, the first arsenate of lead spray was not put on by many orchardists until too late—*i.e.*, after the eggs had hatched, and the young fruit had formed.

It is generally two or three days before the newly emerged Codling Moths begin to oviposit and the eggs require from ten to twelve days to hatch. Thus moths emerging here on 4th October would oviposit about 7th October; these eggs would hatch about 17th October, and in four to five weeks the larvæ would be full fed and ready to leave the fruit; thus, allowing also about another four weeks for the insect to complete its metamorphosis, we might expect a second brood of Codling Moths about the middle of December.

The first spray should be applied soon after the petals drop; the second spray should be applied just before the second generation of eggs hatch.

The importance of obtaining accurate data relating to the oviposition and hatching of Codling Moths' eggs, etc., will thus be recognised.

First-brood larvæ in all stages are now under observation, and it is hoped that useful advice as to later sprayings can be given to growers based therefrom.

The spraying requires to be very thoroughly done and the arsenate of lead kept in a state of suspension during the operation. A power spray outfit of course ensures this, as these appliances are all fitted with an automatically working paddle or mixer.

Many orchardists, however, use a barrel-spray; unless this is fitted with an agitator, it must be kept constantly stirred with a paddle or pole.

The first spray should be made stronger than the later sprayings—*i.e.*, about 2 lb. arsenate of lead paste to 50 gallons of water.

A reliable brand of arsenate of lead should be purchased such as "Swifts" or "Blue Bell." It is also advisable to put on the spray at a good pressure—not less than 100 lb. to the square inch. The tree should be well covered with the spray which must be liberally used, a large tree requiring quite 2 gallons.

The Codling Moth is a serious pest and will, unless systematically fought, do more damage than the fruit fly this season.

Grape Moth Caterpillar.

The caterpillar of a small moth belonging to the Family Tortricidæ, has been found in the Stanthorpe area doing a good deal of damage to the grape vines by eating the young grapes and buds and webbing together the bunches and leaves. The caterpillar when full grown is about $\frac{5}{8}$ of an inch in length and less than 1/16 inch in diameter; it is a greyish green in colour and very active, and when disturbed drops from the vine, sometimes on a fine silken thread. When full fed it spins a leaf or leaves together and turns to a dull brown chrysalis, remaining in this stage only for a day or two. The moth which has been bred out in the Insectary has been forwarded to the Government Entomologist in Chief, Mr. H. Tryon, for identification.

Chrysomelid Beetle.

A little bronze beetle about 3/16 of an inch in length and stoutly built is also abundant on apples and grapes this season. It causes considerable damage to the grape vines by eating the young tender buds and small grapes. It injures the apple by gnawing the skin and rendering it unfit for market, and also it does a good deal of damage to the young foliage and buds. The native hostplant of this beetle is, I believe, the wattle (*Acacia* sp.) in which it may always be found plentifully. This wattle, which I have not yet identified, is to be found growing in the scrub surrounding most orchards.

Both this insect and also the foregoing one can be kept in control by using a spray made by dissolving 1½ lb. arsenate of lead paste in 50 gallons of water.

Orthorhinus Beetle.

The grub or larvæ of this beetle has been again found in grape vine canes; only two specimens have been so far secured, and I do not look upon it as a pest of economical importance. The beetle is the well-known weevil commonly named "Elephant Beetle," owing to its long snout or proboscis. It is a true weevil belonging to the Genus Orthorhinus (*O. cylindrirostris*). It may often be taken flying to the lamps at night.

Fungus Diseases.

Owing to the exceptionally dry season very few fungus diseases have been met with. One, however, injurious to the plum is now in evidence, and specimens have been secured for the Pathologist, Mr. H. Tryon.

ABSTRACTS AND REVIEWS.

All foreign agricultural intelligence in this Section, unless otherwise stated, is taken from "The International Review of the Science and Practice of Agriculture," published at Rome by the International Institute of Agriculture.

A Tractor Worked on Palm Oil.

GASTHUYS, P.—Rapport sur le concours de Tracteurs a' l'huile de palme organise par le Ministre des Colonies a' Bruxelles, en 1920-1921. Bulletin des Matieres Grasses (reproduced from Bulletin Agricole du Congo, Belge), No. 2, pp. 49-63, Marseilles, 1923.

In September, 1921, at the Exhibition of Colonial Tractors organised by the Belgian Colonial Office, the Stockholm firm, Svensen, exhibited a tractor worked on palm oil, called the "Avance" tractor.

This tractor-plough, which is described in detail, weighs 2,900 kg., and consists of two breasts which are easily regulated automatically, for lifting and earthing, and are attached to the frame by means of strong springs. If the plough encounters an obstacle the springs yield and the engine is disconnected immediately; this renders the tractor inactive, which prevents damage, especially on dry, hard soils, such as are met with in the Colonies.

This semi-Diesel two stroke engine is easily worked, durable, and suitable for use with vegetable oils, petrol, or paraffin. A special cylinder is supplied for palm oil and other fatty fuels, of the consistency of butter or solid, and an aluminium reservoir for the liquefaction of fatty substances. The heat which is transmitted from the cylinder to the walls of the reservoir is sufficient to melt the combustible substance.

Tests.—The engine is of the single cylinder type, upright, double stroke, provided with a heat bulb (partly cooled), and arrangements for an air blast. The characteristics are:—10 h.p. normal; diameter of cylinder, 174 mm.; piston stroke, 186 mm.; number of revolutions, 550 p.m. When palm oil is used as fuel this is calculated at 579 revs. per minute, which is according to pulley strength 9·96 h.p.; fuel consumption, from 322·4 gm. per b.h.p. per hour.

Using heavy mineral oil, the number of revolutions is estimated at 572; pulley strength of motor, 10·08 h.p.; fuel consumption, 261·9 g.m. per b.h.p. per hour.

No deviations were noted during the thirty minutes' trial.

Practical Trials.—The tractor moves automatically along the ground at a rate of 3·8 kilometres per hour, gives no trouble, and does not cut up the roads over which it passes.

(*a*) *Ploughing Tests.*—On 6th September tests were made, using petrol, along the edge of a field of heavy soil, beaten down in places by the passage of vehicles and extremely hard after six months of severe drought. The details of the work were as follows:—1 hectare ploughed in 5 hours 45 minutes to a depth of 14-16 cm., at a uniform speed of 3·6 km. per hour; fuel consumption of heavy oil, 19·05 kg., or 21·9 litres (cost 30 centimes per litre). Hence, the cost of fuel is considerably less than for petrol, with which the results compare favourably.

On 7th September tests were made with palm oil. Under the same conditions, the fuel consumption amounted to 23·4 kg. of palm oil. This was crude and very impure. The double filter reservoir worked excellently, and during the four and a-half working hours there was no interruption caused by any obstruction in the compressor.

(*b*) *Road Trials.*—The tractor, apart from the plough, was attached to a farm wagon with three wheels, weighing 700 kg., and carrying a load of 1,000 kg. On the firm road the towing proceeded satisfactorily, but on the sand the wheels sank to a depth of 26 cm. as the steel tyres are too narrow, the front wheels being only 0·70 m. As in the Congo sandy soils are abundant, it will be advisable to make both the back and front wheels of greater width, and of heavier weight, which would assist handling at turning. At the exhibition at Shrawardine (England) this machine made an excellent impression owing to its durability, simplicity, and low running cost.

Loss in the Grain of Maize in Storage as Silage.

GAINES, W. L., "Journal of Dairy Science," Vol. V., No. 5, 1922.

The grain constitutes two-thirds of the nutritive value of the crop and practically its entire commercial value. It is therefore of practical interest to note that maize harvested as silage is associated with the better use of the stalk for feeding purposes. The loss of dry matter in the grain, harvested and stored in crib and silo during these experiments, which covered a period of eight months, is estimated at 2·25 and 5·08 per cent. respectively.

Methods of Measuring the Volume of Cream on Milk.

HARDING, H. A., KELLY, F. W., and CHRISLER, E. S.; "Journal of Dairy Science," Vol. V., No. 5, 1922.

In the city trade the appearance and volume of the cream on the milk as delivered to the consumer is a matter of considerable commercial importance. This has been recognised by the milk industry, and different methods of measuring the cream have been adopted. There is, however, an almost complete lack of literature on the subject. The authors have made a study of the various methods, and, finding that they were not satisfactory for the study of the influence of plant operations on the volume of cream, there has been developed a simple and accurate method of measurement which has been found readily applicable under working conditions.

This method consists in filling round-bottomed test tubes 1 inch in diameter to a depth of 204 mm. with the milk to be tested. The tubes are cooled immediately in ice water and then kept in a temperature of 40 deg. F. for approximately twenty hours. The depth of the cream layer is measured in millimetres, and each millimetre of cream represents 0·5 per cent. of cream by volume. The volume of cream as determined in this way agrees closely with the volume of cream in milk bottles under similar temperature conditions.

This method has been extensively tested in milk plants, and its advantage lies in the fact that by its use a large number of samples may be collected during a single day, the samples stored compactly, and measurement of the cream made quickly accurately, and quantitatively.

Destruction of Mosquitoes by Eels.

DUBOIS, R., in "Comptes rendus hebdomadaires des seances de l'Academie des Sciences," Vol. 175, No. 10, pp. 431-432; Paris, 5th September, 1922.

From experiments made by the writer it was found that young eels live well for a long time in very impure water, and that in such water they are very active in destroying the larvæ of mosquitoes, and possibly also the eggs of several intestinal worms. They are so voracious at the commencement of spring that the writer no longer found any anopheles larvæ in ponds where there had been large numbers before the eels were introduced.

The writer thinks that it would be very advantageous to keep young eels in all waters containing larvæ of mosquitoes, both in the case of drainage water and other very contaminated waters. The exceptional hardiness of these fish, their low cost, the facility with which they can be caught and transported in large numbers, make them preferable to gold-fish (which have been recommended for killing larvæ), and suggest that they would be very useful for the control of malaria by natural means.

The Teaching of Soil Bacteriology.

BROWN, P. E., in "Journal of the American Society of Agronomy," Vol. 13, No. 8, pp. 323-329; Washington, January, 1922.

It has been said that soil science is the basis of agriculture. It covers an extensive field, and the fact that it is now taught in several courses is not only through pedantry, but also because it has been found necessary in order to impart a thorough knowledge of the subject.

From experience gained at Iowa State College it may be taught with advantage in four courses, of which one is general and introductory, one final and applied, and two intermediary on fertility (especially as connected with chemistry) and on bacteriology.

Soil bacteriology is a branch which has only recently been differentiated from agricultural bacteriology. In the curriculum of nearly all agricultural schools it has not yet been treated as an independent branch, but it is nevertheless of growing importance. At present soil bacteriology can no longer remain an accessory, almost fortuitous subject, included in agricultural bacteriology.

Up to the present time there is still a lack of special works on soil bacteriology; instruction should therefore be oral, and enlivened by discussion and written work, which greatly tend to enlighten the mind.

Certain subjects, such as nitrogen fixation, nitrification, the carbon cycle, the sulphur cycle, the phorphorus problem, the part played by fungi, the occurrence of protozoa, &c., should be emphasised particularly; others of minor importance, such as denitrification, should be minimised. The subject-matter should not be too

technical and intricate, but simple and concrete and directed towards enlightenment in the practice of agriculture, tillage, manuring, liming, drainage, &c. It should arouse the attention and keep up the interest of the pupils; and should be completed by demonstration and laboratory experiments.

The Afforestation of Uncultivated Land in France.

In addition to her forests and woodlands, France possesses over 4,000,000 hectares of uncultivated land. M. Sheron, the Minister of Agriculture, has shown in one of his circulars the advisability of planting this land with trees. The Administration of Waters and Forests makes grants in kind, seeds and young trees), and in certain cases in money, to private individuals undertaking afforestation operations of public utility upon uncultivated land. These subsidies, which are paid out of the Budget funds, are supplemented by moneys allocated to the purpose under the provisions of the law of 31st July, 1920. The grants, which often cover a large part of the total cost of the work, are a great encouragement to the afforestation of waste land.—(''Journal d'Agriculture pratique,'' No. 15, April, 1923.)

Composition and Nutritive Value of Green Forage Silage.

HANSSON, NILS, ''Kungl Landbruks Akademiens Handlingar och Tidskrift,'' No. 5, pp. 413-434; Stockholm, 1922.

The experiments with forage crops described in this publication, in addition to the results noted in the ''Comptes Rendus de l'Institut Central de recherches agricoles'' (No. 221), have led to the following conclusions:—

(1) Leguminous forage crops and hay, if silaged carefully, form a valuable feed for milch cows.

The most satisfactory results have been obtained with fresh green silage consisting of 30 to 50 per cent. leguminous plants, cut when well matured—*i.e.*, when the pods are fully developed.

The forage should be well chopped up and stacked in such a way as to allow free circulation of air. The damping of forage which contains a large amount of dry matter, owing to undue desiccation, and the watering of the upper layers in the silo, helps to exclude the air and encourages good fermentation.

(3) The composition of the silage remains unchanged before and after ensilage. However, owing to moisture evaporation, the content of dry matter increases and certain modifications take place in the composition of the nitrogenous and fatty content (ether extracts).

A large proportion of the albuminoids are transformed into peptones and amino acids, and, owing to their solubility, finally become changed into amides, retaining, however, their former value as albuminoids. Even in cases where fermentation took place under the best conditions, about 10 to 20 per cent. of the total nitrogen content of the forage was transformed into ammonia and was consequently lost.

During fermentation in the silo the sugar and the carbohydrates gave rise to considerable quantities of organic acids, partly fatty acids, lacking, however, the nutritive value of fats. Certain samples of silaged feed considered as quite satisfactory possessed, on analysis, up to 1 per cent. free acids. On the other hand, the presence of butyric acid indicates a badly made silage.

(4) Green silage has a favourable influence on milk production; the effect on the fatty content of milk may be compared with that of neutral forages.

(5) When the silage is well made, 14·3 lb. of silage, consisting of 30 to 50 per cent. leguminosæ, or 15·4 to 16·5 lb. of hay corresponds to 1 food unit.

These two feeds contain 1·75 to 1·80 gm. of dry matter. These figures should be higher in the case of oats and barley silage, or if the silage has not been made successfully.

(6) For milch cows, the fresh silage forms an excellent winter feed and may be used to substitute fresh fodder, at the rate of 33, 44, or 55 lb. or more per cow per day. Thanks to the high content of dry matter, this may also serve to a certain extent to replace straw. Green silage, well turned, contains three to five times more albumin than the roots of forage crops.

(7) Green silage has a dietetic value, and has a slight laxative effect.

(8) Certain inconveniences are, however, associated with cheese-making, more especially in cases where full ripening is necessary. The cheeses made with milk from cows fed on silage often ferment to excess and exude a large amount of gas.

THE LIFE HISTORY AND CONTROL OF INSECTS AFFECTING SUGAR-CANE IN NORTH QUEENSLAND.

By EDMUND JARVIS, Entomologist, Bureau of Sugar Experiment Stations.

The following paper was read by Mr. Jarvis before the Pan-Pacific Science Congress in Melbourne, in August, 1923.

INTRODUCTION.

The habits of insects have long received earnest and world-wide attention from scientists, and in these enlightened days when Nature Study is included in our State School curriculum most people are beginning to realise the urgent need for fuller inquiry into the life-history of many of our injurious species.

Probably some of you present here to-day can recall memories of innocent delight awakened at the sight of some brilliant flower or butterfly at a time when the glamour of early youth cast its golden lustre over the simplest joys of life.

We are, perhaps, somewhat slow to comprehend the spiritual significance of this seemingly instinctive love manifested by children for pure and beautiful objects, and too apt to forget that such early aspirations should not be regarded as mere idle sentiment, but are destined in many cases to eventually yield valuable fruit.

You will ask me, perhaps, what idealism of this kind has to do with cane pests. Do you recollect Sir Isaac Newton's celebrated illustration of that modesty which almost invariably illuminates the lives of our greatest writers and thinkers, in which he compares men with their vast stores of knowledge to little children playing abstractedly on the brink of an immense undiscovered ocean of truth?

We, as economic entomologists, are gazing to-day over that illimitable ocean pregnant with its countless possibilities, and most of you will, I think, agree with me in believing that our attitude during investigation of any great entomological problem should be one of humility, for unless we approach nature in the right spirit she is not likely to impart those profound secrets which may be said to hold the key to ultimate success in control work of this kind.

The various methods of experimentation outlined in this treatise were commenced by the writer in 1914, at Gordonvale, near Cairns, a township situated about 900 miles from Brisbane, within 20 degrees of the equator, having an average annual rainfall exceeding 91 inches, while the minimum and maximum temperatures range respectively from 68 to 83 degrees Fahr. This tropical portion of Queensland is largely volcanic, consisting of friable soils varying from light red to chocolate, the latter class being deep and fertile. Extensive alluvial deposits, constituting the low-lying river-flats, and composed of rich sandy or clay loams, occasionally yield from 40 to 70 tons of cane per acre.

Our so called wet season lasts interruptedly from January to April, the average precipitation during these four months being about 63 inches.

On open forest country the ground is usually covered with blady grass (*Imperata arundinaceum*) and the native flora includes many scattered low-growing trees of such genera as *Eucalyptus, Acacia, Melaleuca, Ficus, Tristania, Timoneus, etc.*

The commonest herbaceous plants are species of *Sida, Commersonia, Urena,* etc., which may be considered of economic value, since these genera include some of the flowers habitually visited by the two scoliid wasps, *Campsomeris tasmaniensis* and *radula,* which are parasitic on some of our scarabæid cane grubs.

PRINCIPAL CANE PESTS.

About twelve years ago, when this Entomological Experiment Station was first established at Gordonvale, the most formidable enemy of the sugar-grower was our notorious grey back cockchafer (*Lepidoderma albohirtum* Water.). Unfortunately this beetle, which occasions an annual loss to the industry amounting, it has been estimated, to hundreds of thousands of pounds, still holds the premier position, and may justly be termed:—

Dread ravager of waving seas of cane,
Strange scaly creature, lowly, yet supreme;
Cursed, but triumphant; fast attaining fame,
Haunting our growers like some evil dream.

Our next pest, although far less serious than the preceding, is *Lepidiota frenchi* Blackb. a smaller melolonthid the grubs of which often prove very destructive to roots of young plant cane.

Other insects of decided economic interest are the weevil-borer *Rhabdocnemis obscurus Boisd.*, *Lepidiota caudata* Blackb., *Anoplognathus boisduvali* Boisd., and the large moth borer, *Phragmatiphila truncata* Walk. About 47 additional insects have been recorded as more or less destructive to sugar-cane, which will be alluded to later on.

LEPIDODERMA ALBOHIRTUM WATERH.

Metamorphosis and Habits.

The eggs of this species are deposited in a chamber of irregular form excavated underground by the female at depths varying from 9 to 18 inches according to the degree of moisture present. They are usually laid either in a mass of from 24 to 36, intermixed with particles of soil, in short strings of two or more, or in adherent groups consisting (so far as observed) of 5 to 17.

In general appearance the egg is obtusely-ovate, creamy-yellow; the chorion being somewhat coriaceous and finely reticulate. When first deposited it measures 4·25 by 2·85 mm., but a fortnight later, when hatching, may attain a length of about 6 mm.

The grub of *albohirtum* has been fully described elsewhere[1] so need not be discussed here. It is, however, of the usual cruciform contour, creamy to bluish-white with light-red vestiture, and during the third instar when fully extended measures 55 by 10 mm.

It feeds from January to June, ultimately pupating at a depth of from 1 to 2 feet or more in an ovate chamber enclosing a space of about 1½ cubic inches.

The pupa, which is one of the largest of the melolonthidæ occuring in our canefields, is dark yellowish-red, about 38 mm. long by 18 in width, and furnished with two very noticeable horn-like processes on the cremaster.

The beetle measures 33 by 16 m.m., being deep-brown (almost black), covered more or less thickly—except on legs and central portion of venter of abdominal segments—with minute, white, sharply-pointed pear-shaped scales. Freshly emerged specimens are uniformly grey and mealy-looking, but after a few nights on the wing become more or less rubbed, the denuded places showing as irregular blackish blotches. A detailed description of the pupal and imago stages was published by the writer in 1921[2].

Habits. After transforming into pupæ during October, the beetles usually lie in the pupal chambers three weeks or longer, waiting until the ground has become sufficiently moistened by rain to enable them to burrow upwards to the surface. Possibly this enforced captivity may be necessary in order that the imago may have ample time to mature, and its chitinous integuments to become properly hardened and ready for flight. Emergence from the soil generally takes place towards the end of November, immediately after the first heavy thunder showers which usually occur during that month.

> Ages untold
> Have watched thy countless hosts awake each spring,
> Crawl from the steaming earth and take to wing.
> Thenceforth mid fragrant gums to freely roam,
> And taste the glories of their native home.

The beetles copulate in big trees at a height of from 10 to 15 feet from the ground, and after remaining twelve to fourteen days on food-plants the egg-laden females invade the nearest plantation, enter the soil, and oviposit directly under or close alongside the stools of cane. The maximum length of life for adult specimens in confinement was found by Girault and Dodd to be about twenty days[3]. This practically agrees with my own experience, as although having bred hundreds of these beetles during different seasons for experimental work, capturing them just after emergence and confining them with food-plants in suitable cages, I have never found control specimens live longer than twenty to twenty-five days. It may be of interest to note in this connection that *Melolontha melolontha* was found by Labitte[4] to live thirty-one days in confinement, which was the shortest period of aerial existence among the 48 coleoptera studied by him; the longest life period being that of *Blaps gigas*, which lived 3,349 days.

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[1] Contribution No. XXX from this laboratory (Girault).

[2] "Queensland Agricultural Journal," Vol. XVI., page 48.

[3] The Cane Grubs of Australia. Bull. No. 2 Div. Ent. Qld. Bureau Sugar Expt. Stations 1915.

[4] Longevite de quelques Insectes en captivite. Bull. Museum d'Hist. Nat., Paris No. 2, 1916, 9 pp.

With regard to the larval condition of *albohirtum* there are three well recognised instars. In stage 1, the grub measures approximately 10 mm., with width of head 3 mm.; stage 2, 35 mm., width of head 5 mm.; stage 3, 50 mm., width of head 8 mm. During stage 1 no material damage is effected to roots, but towards the end of the second instar 12 to 15 grubs feeding under a stool of cane, or half that number if in the third stage, are sufficient to completely destroy it.

This result is of course effected gradually, as, one by one, the cord-like feeding-roots near the surface are bitten through close up to the stick, thus curtailing supplies of food and water, and soon causing the stool to lose its hold of the ground. Wilting of the foliage quickly follows, and the leaf-blades after becoming pipe-like turn yellow, and finally brown. By this time the grubs have generally eaten big cavities in the underground portions of the canes, and the first strong wind brings the stool to the ground. Should this chance to occur in April or May before grubs have finished feeding they usually devour any remaining basal portions of the cane-sticks, and later on pupate directly under the old sets.

CONTROL OF GREY BACK COCKCHAFER.—IMAGO STAGE.

1. Collecting Beetles.

This mode of control has been abandoned in the Cairns district since 1917. although still practised with good results in other portions of Queensland. At Macknade and Ripple Creek on the Herbert River, growers pay so much per acre (up to 150 acres only) into a Pest Destruction Fund, the amount varying from 1s. 6d. to 2s. Such method of payment is considered to be better than that of fixing the amount at so much per ton of cane received at the mill. Naturally the aim of both small and big farmers under the former method would be to produce as much cane as possible per acre, and so decrease the amount of the levy; thus, a 24 ton crop at 2s. per acre would cost a grower one penny per ton to protect from grubs; while a 36 ton crop at the same rate would mean a reduction to three-farthings per ton, and so on. In order to achieve this result, however, he would need to adopt better methods of drainage, cultivation, seed selection, &c., meaning, not only heavier crops, but also minimum losses from grubs, gumming, and other diseases. Beetles are paid for by the quart; 1s. for grey backs, and 2s. for golden beetles. At Ripple Creek last season 8,367 quarts were collected, costing £418 7s., and at Macknade over £280 was paid for 5,618 quarts. *Receivers* get 5 per cent. of the cost of all beetles handled. Growers on the Herbert River are not slow to recognise the value of this controlling factor, since at Ripple Creek last year only two farmers objected to contribute to the fund, and at Macknade every grower subscribed to it. The beetles are caught during the first three weeks following emergence.

In the Lower Burdekin district last season 1s. 6d. per quart was paid for grey-backs, and some of the collectors were reported to have made big cheques in this way. In 1914 no less than 25 tons 11 cwt. of these beetles were caught in the Cairns district, representing more than 8,000,000 specimens, a number able to destroy 11,000 acres of cane, which area, if producing an average, say, of only 15 tons per acre, would mean a loss of 165,000 tons.

Now, since the average annual loss from this cockchafer in the district of Cairns is estimated at about 30,000 tons of cane, it appears that the 25 tons of beetles captured in 1914 were capable of causing injuries amounting to more than five times that of the whole of our annual loss here from grub attack. Even if less than one-quarter of these beetles had oviposited in canefields situated in the area collected over, we should, as a result of this control method, have actually prevented destruction of about 40,000 tons of cane, an amount which exceeds that of our annual loss throughout the Cairns district.

Growers wishing to collect their beetles should plant clumps of favourite feeding-trees, such as *Ficus pilosa* or *benjamini*, close to headlands, at intervals of a few hundred feet apart, as these particular food plants, which are much frequented by the beetles, would probably attract most specimens in the vicinity and also facilitate the collecting of same.

The dead beetles should be converted into manure by the pit-and-lime system, as when used for such purpose they are worth—in the opinion of our Agricultural Chemist, Mr. J. C. Brünnich—about £11 per ton. His analysis of the dried bodies of this cockchafer, submitted to him by us in 1922, is as follows:—

Nitrogen, 10·20 per cent.; phosphoric acid, 1·66 per cent; potash, 1·75 per cent.; lime, 0·27 per cent.; proteins, 63·75 per cent.; fat, 4·82 per cent.

2. Light-traps.

This method of control was first investigated by the writer in 1914, when during three evenings—14th to 16th December—in a space of six hours 170 specimens of *albohirtum* flew into a trap placed in a canefield at Meringa. The average temperature at the time was 76 degrees F., there being no wind, no moon, and a clear sky, while the light used was an acetylene lamp with burner of 21 litres. Having obtained conclusive evidence of positive phototropic reaction, the mode of orientation displayed by these beetles whilst under such influence was carefully studied, this being in my opinion an important consideration, seeing that no form of light-trap is likely to prove serviceable unless designed to take advantage of the method of reaction manifested by the specimens attracted. Later, in 1915, field experiments with specially designed light-traps were carried out, the following summarised data obtained on these occasions being of interest.

(1) Beetles which had just emerged from the ground flew around the lighted trap for half an hour, but did not enter it until daylight had quite disappeared. During November, however, specimens that had been feeding for a few days displayed positive reaction about twenty minutes subsequent to commencement of flight, before darkness had set in.

(2) Great aerial activity is exhibited while the temperature ranges between 75 degrees to 80 degrees F., but at 70 degrees F. reaction is less decided, and at 65 degrees F., ceases altogether.

(3) The duration of the period passed on the wing each evening seldom exceeds two and a-half hours (8 to 10.30 p.m.), and is influenced very materially by the moisture content of the soil. Emergence in 1917 was not followed up by showery weather, and in proportion as the surface soil became drier the time occupied in flight decreased very noticeably. On 21st November, for example (seven days after emergence), *albohirtum* flew for about twenty-five minutes only, the temperature being 76 degrees F., while a couple of days later, the weather still continuing dry and sultry, not a single specimen was heard flying at the usual hour, although the temperature was 78 degrees F.

(4) During moonlight nights (moon nearing end of second quarter) beetles when approaching the trap were inclined to circle around it, influenced, perhaps, by the moonlight, and if failing after several attempts to reach their objective, reaction ceased, and they suddenly became motionless. When this condition had been reached a bright flame placed 2 inches from the head of a beetle did not affect it in the least, clearly indicating a cessation of positive phototropic reaction for the time being.

(5) During dark nights the beetles approach the light in an erratic manner by a series of short flights, settling at brief intervals on the ground or cane plants, and at last plunging headlong downwards at a distance of about 1 foot from the light. Positive phototropism towards acetylene light is very marked in both sexes throughout their aerial existence. In the event of first attempts to reach the flame during windy nights proving unsuccessful, the beetles generally work to leeward of the trap and fly in against the breeze. Reaction ceases a few minutes after capture, the insects then remaining stationary until morning, and apparently unaffected by the entrance or motions of additional victims.

With regard to the possible economic value of light-traps as a controlling factor, this line of research has not been followed up by us on an extensive scale. Results are dependent, unfortunately, to a great extent on the meteorological condition obtaining during flighting period of the beetles. The question, however, is one which should not be lost sight of, and I am of opinion that it might be possible to elaborate some practical system of application that would well repay the labour and expense involved.

It is interesting to note that in 1915, during the latter half of the fighting period of *albohirtum*, a collection of 276 beetles consisted of 196 female and 80 male specimens. Although male specimens are known to predominate for a week or so after the first emergence, the sexes can generally be met with in about equal proportions by the beginning of January, and towards the end of that month previous conditions are often entirely reversed, and females are the more numerous.

3. Control by means of Attractive Odours.

We have good reason for assuming that the movements of this beetle are very sensibly affected by forces of a chemotropic nature, which probably exercise important influences on the flight of the females during the period preceding egg-laying.

Initial experiments in this connection were carried out by the writer in December, 1915, when it was discovered that the greyback was negatively chemotropic to such odours as cajeput oil, acetic and carbolic acids, nitro-benzine, &c., but was not in the least influenced by odours arising from oil of cloves, fish oil, or even fumes of 40 per

cent. formalin. The olfactory sensibilities of this species, however, were sufficiently pronounced to justify me in believing that reaction of a positive nature was attainable.

With view to securing further data, these experiments were continued in 1921, the various odours used being placed in small tins 4 inches deep by 3½ inches in diameter, and resembling those emitted from the stem and foliage of favourite food-plants of the beetle, together with miscellaneous aromas, such as arise from decaying vegetation, soil, roots, &c. Some of these bait-traps were exposed in canefields, being simply let into the ground between cane rows with the top edge of the tin level with the surface, while others were hung among the branches of a large feeding-tree. If we examine the anatomy of the antennal organs of *albohirtum*, it will be noticed that the four lamellæ composing the club are closely covered with olfactory pits or pori, each containing a central peg-shaped body of variable form and length, usually tipped with a short seta. In the female these pits, which occur in the chitinous portion of both sides of the two inner lamellæ, and on inner surfaces of the outer plates, number about 18,500, and in male specimens 24,500. The peg in each pit communicates with the olfactory nerve by means of a delicate fibre.

The club of the male, however, is made up of five plates, the fifth being usually shorter than the others.

There can be little doubt that these highly specialised antennæ aid the beetle in locating the whereabouts of favourite feeding-trees. Should an attractive odour be discovered, it would be a comparatively simple matter to design suitable traps, that when baited with it could be so arranged on plantations as to lure to destruction most of the invading beetles. The possibilities of this facinating method of control have been discussed from time to time in various monthly reports, but it was not until last January that results of an encouraging nature were obtained. Whilst engaged one evening in putting aromas in different bait-traps, hung in this instance to stakes placed about 200 feet apart on open forest country, the beetles of *Lepidiota frenchi* chanced to commence their evening flight, which takes place just before twilight. I was carrying a tray of small bottles, some still containing different aromas, while others had been emptied, although a drop or two still remained around the mouth of these, when suddenly, without warning, a dozen or more *frenchi* beetles flew on to the tray, buzzed about the bottles, and even alighted on my fingers. The aroma that had attracted them was perhaps a combination of several different compounds arising from the assortment of bottles on the tray.

A few days later exposures of additional aromas afforded further encouragement, as *frenchi* beetles were found in four of the traps. In one case two females had been attracted, while another trap—containing water in which two chemicals had been dissolved—had captured four beetles, all of which were of the male sex.

Up to the present nearly a hundred different aromas have been tested in the field, but none have yet proved decidedly attractive to adults of *albohirtum*. However, we hope to be more fully equipped for this branch of investigation next season. Our greyback is a sleepy sort of creature at the best of times, its motions even when on the wing being lumbering and ill-directed. The varied range of its dietary, while somewhat increasing the difficulty of inducing positive reaction towards aromas resembling those emanating from food-plants, offers at the same time a wider field for experimentation in this direction. Adults of *albohirtum* have been found feeding on the leaves of about fifty species of shrubs and trees, most of these, however, seldom being attacked until the foliage of all favourite food-plants in the vicinity has been entirely devoured.

4. Chopping Down the Feeding-trees.

Referring to the destruction of feeding-trees as a means of repression against the beetles, the success of such procedure depends, I think, to a great extent on such factors as the geographical position of an affected area, its surrounding geological formation, and the character, disposition, and abundance of timber in the neighbourhood. Although occasionally of importance as a practical remedy, an indiscriminate cutting down of all trees, even though including food-plants of the beetle, might not always prove beneficial. Such action, indeed, instead of affording relief, might even tend in some cases to aggravate the evil. Before attempting any wholesale destruction of timber, it would be advisable to study the topographical characters of an infested area, as these probably play an important part in the distribution of this formidable insect, and may at times be largely responsible for its continual occurrence each season in overwhelming numbers on certain plantations.

Data obtained in 1915 goes to show that infestation of our cane lands around Gordonvale, for example, has been effected by beetles that were originally transported there from extensive breeding grounds situated many miles westward of the township. Such view of the case is not merely theoretical, but an established fact, verified by the experience of leading growers, many of whom have had unique opportunities for observing the gradual encroachment of this pest during the past twenty-five years.

A beetle of such bulky proportions as *albohirtum* appears, at first sight, to be quite unfitted for extended aerial transportation. I was, in fact, somewhat surprised to find that related scarabæidæ of smaller size were decidedly heavier than this species.

One pound of grey-back beetles represents about 216 specimens, so that in spite of its size, a single individual weighs on an average only 2 scruples, or the weight of an ordinary wine cork.

Anoplognathus boisduvali, although scarcely half as big, is, nevertheless, slightly heavier, while *Calloodes grayanus,* an insect only three-quarters the size of *albohirtum,* turned the scale at about 2½ scruples. These differences in weight, which were determined from living specimens, are doubtless due to variations in the consistency of the exo-skeleton, which in *albohirtum* is practically coriaceous, but in *boisduvali* and *grayanus* comparatively thick and horny. Weakly flight, coupled with large size tends as a rule to retard the spread of moderately heavy insects, although where such drawbacks are combined with unusual buoyancy they are likely to aid rather than hinder rapid distribution; especially when, as in the present instance, bulk is accompanied by a proportionate wing expanse.

Want of space forbids further illustration, but the above evidence will suffice to show that before destroying feeding-trees on an extensive scale the various factors associated with this control method should be taken into consideration.

5. Poisoning the Food-plants.

Investigation of this form of control was commenced in 1915. The type of cage used consisted of a cylinder of perforated zinc fitting into a flower-pot containing about 50 cubic inches of moist soil, in which was buried a small water-bottle to keep the food-plant fresh. A single grey-back beetle was placed in each cage, with leaves that had been previously sprayed with various arsenical solutions, and allowed to dry.

Results may be summarised as follows, figures referring to days to be taken in each case as average numbers.

Lead arsenate 2 lb., molasses 1 lb., water 50 gallons, proved fatal after nine days, during which time 69 beetles devoured 32 sq. inches of poisoned leafage. A similar proportion of lead arsenate with the addition of ½ lb. of soap, killed in 10½ days, the latter ingredient seemingly being less palatable than molasses; since although in this case 62 beetles were employed they consumed only 21 inches during a longer period. Control specimens, thirty in all, feeding on unsprayed leaves, lived 14 days, and did not eat more food proportionately than beetles confined with poisoned foliage.

Further experimentation in 1922 yielded the following data:—Paris green 1 lb., lime 1½ lb., water 8 gallons, proved fatal to the beetles from four to seven days after feeding; while lead arsenate took nine days.

It is interesting to note that this species does not, like some insects, exhibit a keen sense of discrimination in the choice of food, but on the contrary, is comparatively indifferent as to its flavour, being as ready to devour leaves sprayed with poisons, molasses, &c., as untreated foliage. Such impartiality will doubtless facilitate future research in this connection. We may gather, too, from the above-mentioned results that lead arsenate, although slow in producing the desired effect, might be serviceable if applied to trap-trees, &c., immediately after the first emergence of beetles in November, since under normal conditions of life food is partaken of directly after copulation, and oviposition does not follow until about a fortnight later.

No field experiments have been conducted up to the present, but in the event of discovery of a more deadly spray this could be applied to various feeding trees near headlands, or to groups of favourite food-plants grown for this purpose.

6. Soil Deterrents.

Preliminary experiments with deterrents were carried out during 1921, the various substances tested being:—Coal-tar, napthelene, chloride of lime, tobacco-dust, and carbolineum emulsion. These were applied to the surface of the ground between and on either side of cane stools, in order to see whether egg-laden female beetles would avoid soil contaminated in this way, and oviposit elsewhere.

Owing to the crop as a whole having escaped serious damage from grubs, results from this experiment were rendered inconclusive, although we obtained data of more or less economic value.

(To be continued.)

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF NOVEMBER, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALLS DURING NOVEMBER, 1923 AND 1922, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Nov.	No. of Years' Records.	Nov., 1923.	Nov., 1922.		Nov.	No. of Years' Records.	Nov., 1923.	Nov., 1922.
North Coast.	In.		In.	In.	*South Coast*—continued:	In.		In.	In.
Atherton	1·97	22	0·93	0 29					
Cairns	4·03	41	0·60	0·10	Nambour	3·76	27	5·54	1·46
Cardwell	4·08	51	0·22	1·65	Nanango	2·56	41	0·86	2 25
Cooktown	2·71	47	0·03	0·60	Rockhampton ...	2 29	52	2 51	2·21
Herberton	2·33	36	0·85	1·16	Woodford	3·19	36	1·75	2·50
Ingham	3·73	31	0·05	0·46					
Innisfail	6·24	42	0·46	1·93					
Mossman	4·29	15	0·57	0·60	*Darling Downs.*				
Townsville	1·81	52	0·34	0·21					
					Dalby	2·62	53	2·34	0·62
Central Coast.					Emu Vale	2·61	27	2·17	3·78
					Jimbour	2 32	35	0·96	0·49
Ayr	1·77	36	0·25	2 82	Miles	2·43	38	0·18	0·29
Bowen	1·29	52	0·13	0·27	Stanthorpe ...	2 72	50	0·14	3·32
Charters Towers ..	1·54	41	0·06	0·10	Toowoomba ...	3·23	51	1·74	1·81
Mackay	2·89	52	1·22	1·56	Warwick	2·55	58	0·99	4·80
Proserpine	2·90	20	Nil	0·56					
St. Lawrence ...	2·31	52	0·66	0·72					
					Maranoa.				
South Coast.									
					Roma	2·01	49	0·22	0·26
Biggenden	2·66	24	1·79	1·77					
Bundaberg	2·54	40	1·34	0·17	*State Farms, &c.*				
Brisbane	3·65	72	1·23	3·53					
Childers	2·78	28	1·90	1·89	Bungeworgorai ...	1·86	9	0·16	1·09
Crohamhurst ...	4·39	30	3·85	3·86	Gatton College ...	2 61	24	1·84	2·71
Esk	3·13	36	2·26	3 27	Gindie	2·04	24	0·54	2·28
Gayndah	2 80	52	1·79	2·56	Hermitage ...	2·63	17	0·89	2·99
Gympie	3·14	53	3·63	2·46	Kairi	1·93	9	1·92	0·29
Glasshouse Mts. ...	3·54	15	3·13	1·24	Sugar Experiment Station, Mackay	2·59	26	0·23	1·74
Kilkivan	2·58	44	2·23	2·22	Warren	3·27	9	1·47	2·09
Maryborough ...	3·09	52	2·12	1·55					

NOTE.—The averages have been compiled from official data during the periods indicated; but the totals for November this year, and for the same period of 1922, having been compiled from telegraphic reports, are subject to revision.

GEORGE G. BOND,
State Meteorologist.

QUEENSLAND TREES.

By C. T. WHITE, F.L.S., Government Botanist, and W. D. FRANCIS, Assistant Botanist.

The South Queensland kauri, *Agathis robusta,* is now rare on the mainland. A fair number of trees are still growing on Fraser Island. The species is limited to a comparatively small area on the mainland, from Eumundi on the South to Maryborough on the North. The trees, when full grown, are an impressive sight. The regular, round stems attain as much as 8 feet in diameter and 80 feet in height before they branch. Sometimes the trees attain a total height of 140 feet. The tree shown in our picture was growing on the roadside at Kin Kin, and was reserved for scenic purposes, but about five years ago it was uprooted by a storm. Its barrel measured 8 feet in diameter and about 70 feet in height to the first limb.

Photo. by W. D. Francis.]

PLATE 1.—SOUTH QUEENSLAND KAURI (*Agathis robusta*).
A tree once growing in the rain forest at Kin Kin, North Coast Line.

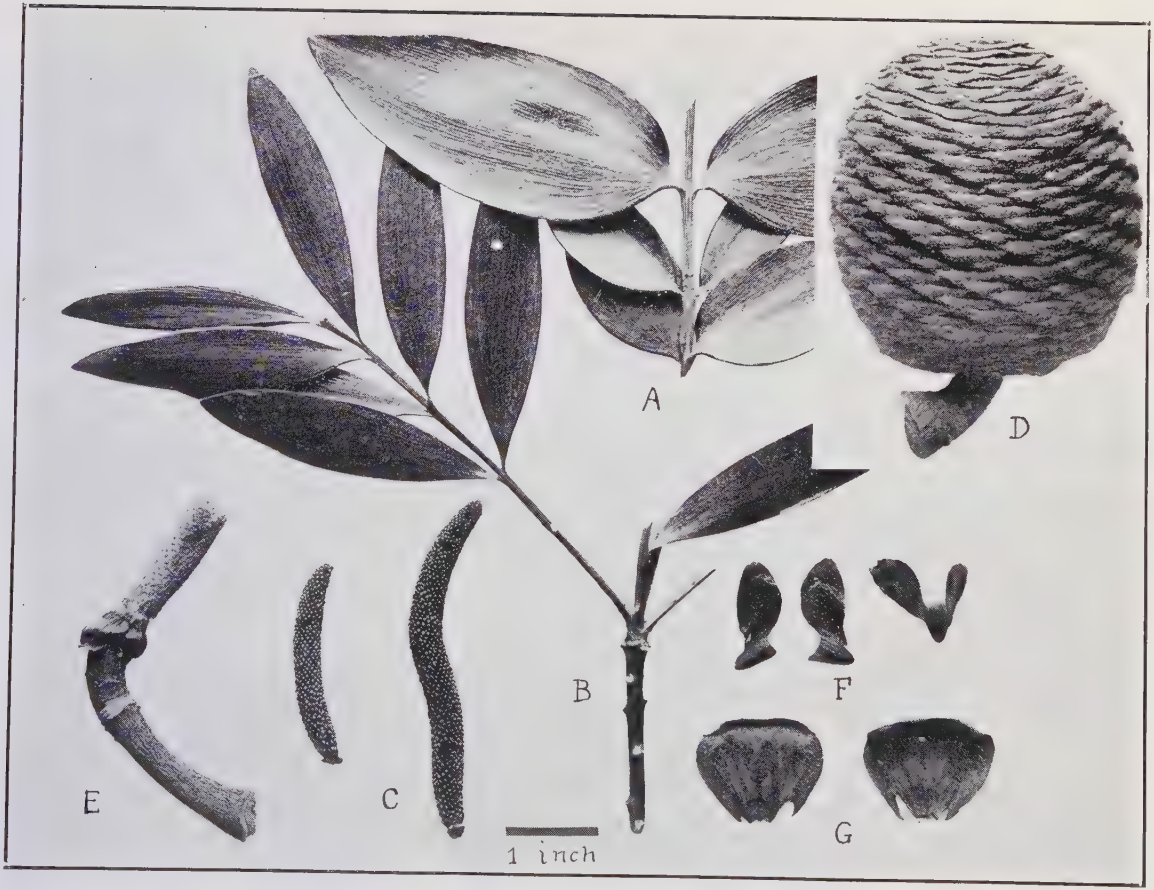


Photo: Dept. Agriculture and Stock.]

PLATE 2.—SOUTH QUEENSLAND KAURI.

A.—Coppice shoot. B.—Shoot from mature tree. C.—Male catkins. D.—Cone. E. Axis of cone. F.—Seeds. G.—Cone scales.

BREEDS OF PIGS.

E. J. SHELTON, H.D.A., Instructor in Pig-Raising.

The first article of this series, "Classification of Pigs," was published in the November Journal. In the last issue the points of the Berkshire were set out. In succeeding issues other breeds of Pigs and matters of moment to Pig raisers generally will be discussed.—Ed. Q.A.J.

THE TAMWORTH.

Early History of the Breed.

Included in the list of pigs suited to the climatic conditions and environment of Queensland, and to the requirements of pig-breeders generally, we find the Tamworth breed occupying a very prominent place.

Originally a gaunt, grey, gristly, rough type found in the forests and marshes of many of the inland counties of England, they were the first breed of pig our forefathers attempted to domesticate and make use of on their farms. The breed did not originate, as many Southern breeders imagine, in the district around Tamworth, N.S.W., but is the original old English "native" or "wild" pig, taking its name from Tamworth, one of the midland counties of England on the borders of Stafford and Warwickshire.

Their Special Qualifications.

The breed is pre-eminently a bacon pig, producing a maximum of lean meat from its long, fleshy, deep-sided carcase. Tamworths have come largely to the front rank in recent years owing to their usefulness on the farm for crossbreeding purposes—*i.e.*, for mating with Berkshires and similar types for the production of an ideal bacon pig of maximum weight and condition, and with a well-marbled, firm, flesh of good quality, such as is nowadays required by all bacon-curers.

The original intention of the improvers of this and other British breeds was not specially to produce this "medium weight" pig, but rather to improve the commercial value of the animal as it was in those days, and to increase both its size, weight, and productive capacity. As a matter of fact, they had a craze for size and weight, both very useful qualities, but both unobtainable without a certain coarseness in the flesh and bone and heavy feeding qualities.

The breed as they found it in the wild state exhibited a fierce temper. They were long, lean, gaunt, gristly, and much given to roving. They were not noted for any of the qualities which make the breed so successful to-day except constitution and an aptitude to withstand the harsh, rough conditions inseparable from the wild state in which they lived. The early improvers of the type, however, made use of these qualities, and by careful breeding, judicious selection and feeding, with reasonably good housing, they soon began to note that improvement which they so much desired. Then came the demand for size, and Tamworth pigs were fed to enormous weights.

The interest created by this craze led breeders to strive to out-do each other in their attempts to "win the prize," and so gradually the conditions under which pigs had been kept were improved upon.

It was as a result of the success thus attained and with the general desire on the part of live stock fanciers for a better class animal that the next forward step was made—viz., the introduction of the Chinese and Neapolitan breeds, the special objective being the production of the breeds now known as the Berkshire and the several types of Yorkshires.

The improvers of the Tamworth pig, however, did not approve of the introduction of foreign blood, and they stuck to the pure-bred animal and trusted to careful selection and improved methods of feeding and housing to produce the desired characteristics.

The Admittance of the Tamworth to the Herd Book.

It was not until the year 1897 that Tamworths were first included as a separate class in the Pig Schedule at the Royal Agricultural Shows in England, though they had been exhibited for over thirty years prior to that date; it was also during the "nineties" that they were first admitted into the stud book. They are now bred throughout the world, and, as we have them, they are distinctly suitable for the breeder of bacon pigs.

[Photo: Country Water Conservation and Irrigation Commission, N.S.W.]

PLATE 3.—GRAZING FORMS AN ESSENTIAL PART OF THE PIG'S UP-KEEP. PIGS GRAZING ON LUCERNE ON AN IRRIGATION FARM IN N.S.W.

This settler commenced operations with a purebred Tamworth boar and sow and several Berkshire sows. Note the crossbred (spotted) pigs and the parent stock (sows).

PLATE I.—AN OLD CHAMPION.

Tamworth Boar, "Sandy MacQueen." A well-known Australian prize-winner.

The Present Day Type.

The Tamworth is not, however, even in his improved form, a "popular pig," in the same sense as is the Berkshire; this is not due to any particular fault, but to a general lack of knowledge of the breed and of their useful qualities. Whilst we have very many breeders of Berkshire and Yorkshire pigs, the Tamworth breeders are few and far between. The breed is undoubtedly increasing in popularity and has been improved considerably in the last ten years.

They are distinctly "red" in colour, the variation being from a golden-red hair on a flesh-coloured skin, to a dark red or brown, or even a yellowish shade. The colour varies also a good deal in its intensity. There are some types (not by any means desirable) which exhibit a very light yellow or a "ginger" shade, others the reverse; these are also unsatisfactory, and should be rigorously culled. The desirable and popular colour is a golden-red hair on a fleshy-coloured skin, free from black splashes or spots.

In inferior types the conformation also varies, some of the older strains are of a "racehorse" build, these are undesirable in every way and should not be tolerated; in fact, with the Tamworth more so than with any breed, only the very best types should be used and in order to ascertain what is the best, breeders should lose no opportunity of studying the types winning in our Royal Shows. The best class of Tamworth is one carrying a compact, deep carcase, well covered with a fine-quality flesh intermingled with a fair percentage of firm, white fat.

The young, growing Tamworth pigs might, to the inexperienced breeder, appear weakly and unthrifty; they certainly look "leggy" and narrow in comparison with more "blocky" breeds, but as they grow, they develop rapidly and fill out. This fault is not so noticeable in the crossbred—*i.e.*, where the Tamworth is mated with the Berkshire, &c., but they certainly require all the attention it is possible to give them, otherwise they will be less profitable than some of the other breeds. Tamworths must be forced along, particularly for the first four or five months, after that they are able to look after themselves better than most other breeds. These failings doubtless account somewhat for a certain timidity amongst breeders in taking up this type. The Tamworth sow invariably develops into an excellent mother, providing an abundant supply of rich milk for her numerous sons and daughters.

Of course, one finds "duffers" amongst this as amongst all other breeds. It is the individual animal that one must judge by, and not the breed, in making a choice of breeding stock. No breed should be condemned on account of their being "black sheep" in the flock.

Tamworths: A Hardy Vigorous Type.

The Tamworth pig does not suffer as a result of sunburn or sunscald, and they thrive in the warmest climates. This makes them especially suitable for our coastal and for the comparatively warm, dry, inland areas. They are, perhaps, not quite so suitable as the Large or Middle Yorkshires for colder climates. The "Tammy" does not like to have his ears "frost-bitten"; he prefers the warmer, more genial climes.

Tamworths have "big" appetites. Some breeders consider this a serious fault, and so it is insofar as a "cottager's" pig is concerned, and this applies in many ways to farmers keeping only one or two "sty" pigs; but to the man who is breeding pigs on a large scale and is feeding them on cheap home-grown foods, it is not at all a serious fault, so long as the animal produces a reasonable amount of increase in weight for food consumed. For this reason it would not be correct to say that the Tamworth makes an ideal suburban pig farmer's type, for there are other breeds and crosses more suited to those conditions—*i.e.*, the Poland China, the Middle Yorkshire, or the popular Berkshire—these are the types for the "city and suburban" man.

The Tamworth is not to be considered a profitable pig at all as a pure-bred (meat) market pig; he must be crossed with the Berkshire, Yorkshire, or Poland-China to produce the best results. However, the Tamworth is growing in popularity as a "stud" pig, though there have been but few men specialising in these "red" pigs in Australia.

The Tamworth is not a pork butchers' favourite, and even the Tamworth crosses cannot be classed as porkers, though the writer has been forced to judge Tamworth-Berkshire crosses entered as porkers on many occasions at shows.

The Tamworth is the bacon breeders' ideal type for crossing purposes. The cross between the Tamworth and the several other breeds referred to above are almost a model type if well fed and cared for from birth to maturity. The second cross (but not the mongrel)—that is a Berkshire boar mated with a first-cross Tamworth-Berkshire sow—undoubtedly produces a very fine type of bacon pig. Some curers

PLATE 5.—A WELL-DEVELOPED LITTER.
Sired by a Tamworth boar. The dam is a sow of the Poland-China breed. The cross produces very useful bacon pigs also.

PLATE 6.—A GOOD QUALITY TAMWORTH BOAR FROM THE HAWKESBURY COLLEGE STUD, N.S.W
Note the evenness of type and compact, well-fleshed body.

and breeders like a "dash" of Middle Yorkshire in this type, and prefer the Yorkshire-Tamworth cross. The writer prefers to stick to the "Black and Reds" in these warm climates. All these are important considerations to be remembered when selecting breeding stock.

Other Characteristics of the Tamworth.

Contrary to the opinion of some breeders, the Tamworth is a docile, tractable animal, responding, as all animals do, to the character of the treatment accorded them. The sows are possessed to a remarkable degree of the qualities of motherhood, including ease of conception and giving birth to large litters, they produce a liberal supply of milk and are very attentive to their youngsters.

One writer has said that "long-nosed pigs" are always more prolific and develop into better mothers than short-nosed types; but, whilst there may be something in this, it is by no means true in the case of "wild" or "bush" pigs.

Discussing the Tamworth, one noted English writer says—"As all stockraisers are concerned in producing the best, and nothing but the best, it behoves them to seriously consider the breeding and feeding of the Tamworth pig for crossing with the common barn-yard type of sow, as they produce pigs of the very highest quality at a low cost."

As a "show" pig the Tamworth has not had to face much competition at Australian shows, as the number of breeders specialising in them is very limited, though some very payable prices have been obtained, but when fed liberally and properly prepared for the show ring, there is no more attractive looking animal than the "Tammy."

It would be well for the inexperienced breeder to learn all he possibly could about this type before going in too largely for them, especially from a stud breeder's standpoint.

Tamworth Eligible for Entry in the Stud Book.

Tamworth pigs, provided they conform to the recognised standards of the breed, and have been bred from registered stock (or stock eligible for registration), and are properly fed and cared for, may be admitted into the Herd Books of the Berkshire and Yorkshire Society of Australasia, a local branch of which has recently been formed. Registration is necessary if the parents or any of the progeny are to be exhibited at any of the Royal Shows or the larger country shows whose rules have been brought into line to provide for this. This registration of stud stock has been a powerful influence for good in the "pig world," and no breed has benefited more than the Tamworth has done.

The principal characteristics of the breed, as set out in the standards adopted by The National Pig Breeders' Association of England, in whose herd books Tamworths are also registered, are as follows:—

Colour.—Golden-red hair on a flesh-coloured skin, free from black hairs or patches.

Head.—Fairly long, snout moderately long and quite straight, face slightly dished, wide between the eyes and ears.

Ears.—Rather wide, with fine fringe of silky hair, carried rigid, but inclined slightly forward.

Jowl.—Small and light.

Neck.—Fairly long and muscular, especially in the boar.

Chest.—Wide, deep, well proportioned.

Shoulders.—Fine, of good shape, and well set.

Girth.—Large, allowing for ample room for heart and lung action.

Sides.—Long and deep.

Ribs.—Well sprung, and extending well up to the flank.

Loin.—Wide and strong, well filled and even.

Belly.—Full and thick, with straight underline, and at least twelve well-developed and evenly placed teats.

Flank.—Full, loose, and well let down.

Quarters.—Long, wide, and straight from hips to tail.

Hams.—Broad, full, and well let down to the hocks.

Tail.—Set on high and well tasselled, but not coarse.

Legs.—Strong, straight, shapely, with plenty flat bone; legs should be set well outside the body.

Ankles.—Strong and compact.

Pasterns.—Short, and yet springy.

Feet.—Firm and strong, but not splayed.

Skin.—Smooth, pliant, and free from wrinkles.

Hair.—Abundant, long; straight and silky, especially in sow.

Action.—Free and clean.

Symmetry.—General style and gait indicating breeding and good constitution, even temperament, &c.

Objectionable Features in Both Boar and Sow.

Head.—Narrow forehead, kinked or upturned nose.

Ears.—Thick and coarse or drooping too far forward; loose and lopped ears are also objectionable.

Jowl.—Thick, coarse, and heavy.

Shoulders.—Coarse, heavy, or wide, and open at the top.

Ribs.—Flat or short curved, light back ribs.

Loin.—Narrow or weak.

Belly.—Flaccid, or wanting in muscle, gutty or podgy.

The Disqualifications Include.

Colour.—Black hairs or patches on the skin.

In Boars.—Rupture, or only one testicle let down, vicious temper, coarse, wrinkly or ungainly.

In Sows.—Deficiency in or very irregularly placed or blind teats, injured or diseased udders, vicious temper, hollow back, coarse or heavy mane; poor breeding qualities.

IMPORTED LUCERNE SEED.

The Acting Premier and Minister for Agriculture and Stock (Hon. W. N. Gillies) has directed attention to the Regulations under the Commerce (Trade Descriptions) Act of 1905, under which all imported lucerne seed, in addition to the marking required by the Act, must be stained in such a manner as to distinguish it from Australian-grown seed. For the information of importers the Regulation is quoted:—

> "Lucerne seed shall contain no foreign seeds or substances, and shall, when tested by an officer, show germination to the extent of at least 80 per cent. A Proclamation has been issued under the Customs Act, 1901-1920, prohibiting the importation of lucerne seed unless such seed is stained with fine polishing rouge. The staining must be effected by first thoroughly mixing the total bulk of the seed with one-tenth (1-10th) part of 1 per centum of refined cotton seed oil in a closed vessel (*i.e.*, revolving barrel); subsequently one-quarter ($\frac{1}{4}$) of one per centum of fine polishing rouge must be added, and the mixing continued until the added colour is uniformly distributed on the seed."

Farmers or other buyers would do well to note that lucerne seed of a distinct reddish colour is of foreign origin.

IRRIGATION IN QUEENSLAND—VII.

H. E. A. EKLUND, late Hydraulic Engineer, Queensland Water Supply Department.

The first of this series, a historical note, was published in the July Journal. Irrigation in the Lower Burdekin was reviewed in the August number, and the instalment in the following issue covered Irrigation in the West. In the October Journal practical considerations were discussed, the November number contained notes on Surface Supplies, and last month's instalment covered notes on the Duty of Water and the preparation of lands for irrigation. The series will be concluded in the next issue.—Ed.

SYSTEMS OF IRRIGATION.

The system of irrigation to be employed depends on three things:—

1. The natural surface contour in its original state.
2. The crop to be grown.
3. The quality and peculiarities of the soil.

(1.) The natural surface contour in its original state.

It would evidently not be good practice to attempt grading on a piece of very undulating land where the variation in level reaches several feet per chain. Under such circumstances, therefore, grading would be too costly, and some other method, perhaps a spray system, would suit such a condition best. But though perhaps not so evident, it would be equally unnecessarily expensive to indulge in a spray system when a little grading would have permanently rendered the area suitable for treatment by some of the cheaper methods.

It is not denied that spray systems are excellent in their place; perhaps in some cases the only kind of appliance that would make irrigation possible. But as every foot of lift means more power and, therefore, more cost, the question of system to suit the natural configuration of the ground needs very careful consideration.

Though it may appear an unnecessary outlay at first, anyone contemplating irrigation will find it money well spent to, as a first step, get all the definite information about the proposed irrigation plot on paper. It does not necessarily mean that a licensed surveyor has to be employed; any qualified leveller can do the work; but a novice should not be trusted. The appearance of fairly flat and level ground is so intensely misleading, that unless it has been seen under water at some time or other the last thing that should be trusted to determine the direction of fall is the human eye. The proper contouring is, therefore, the one essential preliminary to all irrigation.

(2.) The Crop to be Grown.

Just as different crops need differing methods of cultivation to yield the best results, so do they need different methods of irrigation; or perhaps it would be better to say that the system of irrigation used for any crop must be such as to fit in with the cultivation necessary. Lucerne is not grown in rows or drills, therefore the furrow system of irrigation is not usually adopted for watering this crop.

(3.) The Peculiarities of the Soil.

This feature needs the most careful study of any, but any system adopted on account of this factor is chosen because of the degree or variation of amount of application at any one time which the system decided upon makes possible. This has already been considered under "Character of Soil."

It is evident from the above that no definite rule can be laid down as to the kind of system to be adopted to meet general cases, but having these considerations before him they may help the intending irrigator and may at least prevent him from deciding on a wholly unsuitable plant.

PLATE 7.—GAUGING WATER.
Upstream side of Weir Board, showing small Bracket on which rule is held when Measuring Flow.

The Furrow System.

This method, as the name indicates, consists in supplying water to the crop by furrows. It is the most common in this State, as irrigation is mostly adopted where larger plants are grown. It is the most suitable system for sugar-cane, maize, vines, orchards, sorghum, potatoes, and even other root crops, beans, peas, and cabbages—in fact, any crop planted in rows or drills. The particular advantage of this system consists in that the whole surface of the ground is not covered and "caking" is minimised. "Caking" of the soil after watering does the crop harm, especially if it extends over the whole field. If the water is confined to furrows it is evident that only the furrow will cake, and whether the water has been applied to the row, or between the rows, subsequent cultivation is rendered more simple and easy. As the water applied will reach the growing crop on each side of the furrow, only alternate furrows need be watered for a light application.

The length of the furrow must be limited according to the quality of the soil. In open, porous soil it is not good practice to have the furrow longer than 250-300 feet. If longer, the end next the head ditch will be over-soaked, while the far end just gets enough, and if water is shut off from the furrow when the top end has had the right amount the bottom may still be dry. In heavy soils furrows up to 500 feet are not as a rule too long.

The best method of supplying water to the furrows from the head ditch will also depend on the character of the soil. If very porous the maximum amount that can be admitted without scouring should be run in, so that the water will find its way to the far end as soon as possible. Especially is this necessary if it is intended to give a light application. For such land the sluice box should be 12 inches wide.

Where heavy soils are met with a small stream has to be used to give the water time to sink in. It is evident that a number of openings may be operated simultaneously. The number opened at the same time is only limited by the amount of the supply, and in concrete ditches of the semi-circular or other type when used for heavy soils, a 2 or 3-inch hole is provided and lined with galvanised iron. The outer end of this short tube has an adjustable shutter and in this way the desired quantity of water is admitted to the furrow.

Knowing the length of the furrow, the amount of water coming through the openings in the sluice box, and the number of furrows per chain, it is a simple matter to arrive at the quantity applied. Say that the rows are 330 feet long and 6 feet apart. Then the number of furrows per chain equal eleven and the rows per acre twenty-two. If water is admitted to eleven furrows at a time the area dealt with is half an acre. From Table VII. we get 22,650 gallons = 1 inch per acre. Hence a depth of 3 inches for the area under consideration (namely, ½ acre) is practically 33,920 gallons. This amount divided by 11 = 3,083, the number of gallons to be supplied to each row. Looking now at Table XIII: it will be seen that an opening 8 inches wide and between 3 and 4 inches high will supply the desired quantity in about ten minutes.

If the amount of supply available in the head ditch is only 1,000 gallons per minute, and it is still desired to have each sluice deliver approximately 300 gallons per minute, the number of rows dealt with at a time is only three, as a certain amount is always lost by seepage.

Dr. Maxwell, in describing irrigation in Hawaii, states:—"In the Hawaiian Islands sugar-cane is irrigated exclusively by means of ditches and furrows. In laying out a field to be planted in sugar-cane the first step is to make a survey of the area and to determine its contour. The notes of the survey will show the direction in which the cane furrows shall be constructed, and also show where the laterals which feed the furrows should be located. On uneven ground the furrows are curved in order that the grade may be kept uniform.

"If a field is practically level . . . the furrows are dug straight through the field. The most level field, however, usually has a dominant decline in some direction which is generally determined by the general formation of the lands of the region. The Hawaiian Islands are of volcanic origin and hence the general slope of the land is from the craters to the sea. The country is mountainous in the neighbourhood of the volcanoes. The slopes become flatter as lower levels are reached, until the decline apparently disappears in the lands bordering on the sea coast. The latter have been deposited by streams running from higher lands. In spite of the flat appearance of these lowlands they generally have a decline towards the sea, which is not only sufficient to make the distribution of water a simple matter, but also to affect the discharge of underground water. This, however, is not always the case, the writer having several tracts in mind where the ground water cannot find a discharge owing to its surface being but slightly above the level of high tide."

The following diagram is given by Dr. Maxwell as indicative of the practice for growing sugar-cane, but as the system holds good for any crop grown in rows, it is reproduced below with the description given:—

"In the diagram Fig. 45 the lines indicate the rows of cane which are assumed to be 5 feet apart, the usual distance. In some situations owing to local causes the distance between the cane rows may be as much as 6 feet or as little as 4½ feet. The distance between the laterals is assumed to be 30 feet, which means that the water is intended to flow only 15 feet from each side of the laterals (or head ditches) that are feeding the furrows. The lines running midway between but parallel with the laterals represent earth dams in the furrows. These limit the length of the flow of water from each side. Only lands having a very even surface can be laid out on the simple plan of the diagram."

It is obvious that for many classes of soil and where the slope of the land warrants it, the above plan requires an improvement. Such a lay-out is shown in Fig. 46, where any surplus water is drained off the land, and this water carrying dissolved plant food is far too valuable to be allowed to run to waste. At the Bingera plantation, in the Bundaberg district, the whole area is tile-drained and the surplus water taken by a low-level drain or ditch to a reservoir from which it is again pumped up to a level from which redistribution can be effected. The economy thus effected is not only in getting a large volume of water from a low lift, but it is chiefly the quality of the water that is valuable, as it is full of nourishment for the plants.

Another common lay-out is shown in Fig. 47, the disadvantage in this law-out being that the length of the rows is usually too great. For porous soils it is not to be recommended, because as already explained the seepage becomes large.

The detrimental effects of over-irrigation are also mentioned by Dr. Maxwell, and the results of some analyses carried out under his supervision of water obtained from sub-drains are interesting:—

"FERTILISING CONSTITUENTS LEACHED FROM SOIL BY EXCESSIVE IRRIGATION.

Loss of Water.	CONSTITUENTS REMOVED FROM SOIL PER ACRE.		
	Lime.	Potash.	Nitrogen.
58,000 gallons ..	278 lb.	61 lb.	117 lb.

"If the lift is 30 feet, the motive power an oil engine, and the price of oil 2s. 6d. per gallon; lime £5 per ton, potash and nitrogen, say £20 per ton, the actual money loss per acre under above conditions is something over £2 per acre. This apparently explains why some would-be irrigators have been heard to say that—"Oh! I put plenty of water on, but it didn't seem to be much good."

"HE WHO MEASURES—KNOWS."

Other methods of irrigating, at present in very limited use in this State, are the Border Method, the Check Method, spraying, and, in a crude and limited way, flooding.

The Border Method.

As the name implies, water for irrigating each plant is obtainable on the border of the plat. The land is divided into strips bounded by low levees, the length of the strip usually extending in the direction of the sharpest slope.

The area confined within the levees bordering the land is well graded and thoroughly smoothed. The water is admitted through one or more sluice boxes from the head ditch until a sufficient quantity has been let in.

This method of irrigating is, like the check system, almost exclusively used for fodder or grain. Having a head of water of from 3 to 10 cubic feet per second, large areas can be covered in a short time and the irrigation of a cheaper crop can thus be carried out with profit; as much as 80 acres having been irrigated by two men in twenty-four hours.

The system is suitable for light and open soils, provided that the "head" obtainable is large. The width of the lands between borders may be from 40 to 60 feet, and the length as much as a quarter of a mile.

The earth wanted for levees is usually taken from each side of the levee and a depression is thus formed. This causes hollows where water will lodge, and the depression also makes the harvesting of the crop difficult. The better way is to take earth from the high places for forming the levees, and have the finished surface as level as possible.

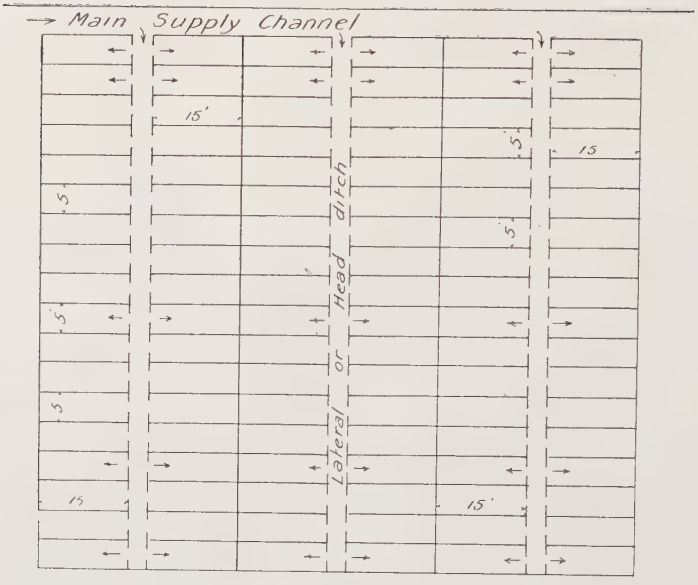


Fig. 45 Scale: 20' = 1"

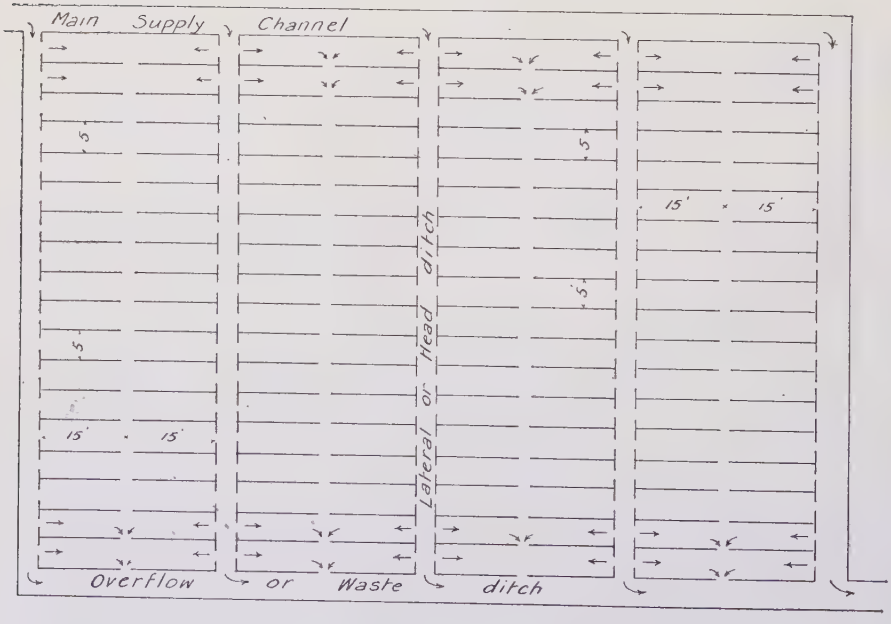


Fig. 46.

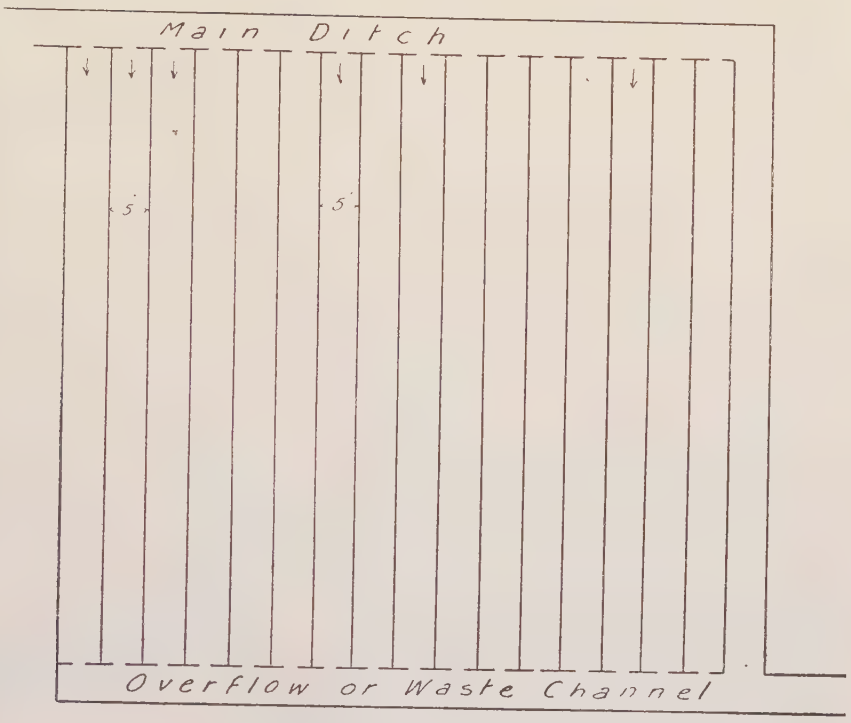


Fig 47

Scale: 20' = 1"

The Check System.

The check system, one form of which is shown in Fig. 48, differs but little from the border method. Checks may be rectangular and symmetrical or follow the contours as contour checks when they may be wholly unsymmetrical. The former or rectangular check is usually more easily constructed, but if the ground is difficult the contour check may in the long run prove the more economical of the two.

The checks themselves consist of a low levee or bank surrounding a piece of land which when finished is perfectly smoothed and as nearly dead level as possible. The water for irrigation is admitted from the head ditch (as in the border method) to the first plat of land. From this it is let into the next, and so on.

It is an economic system and ranks second to the border system only for amount of land covered by one man in a specified time. With the check system it is stated that one man can efficiently water from 7 to 15 acres in ten hours, so making the cost of applying water a reasonable charge.

It will be recognised, of course, that a field heaped up into a series of checks has drawbacks from the cultivators' and also the harvesters' point of view. The loading capacity on farm vehicles is distinctly limited and damage to implements might easily occur in crossing the levees unless special precautions are taken.

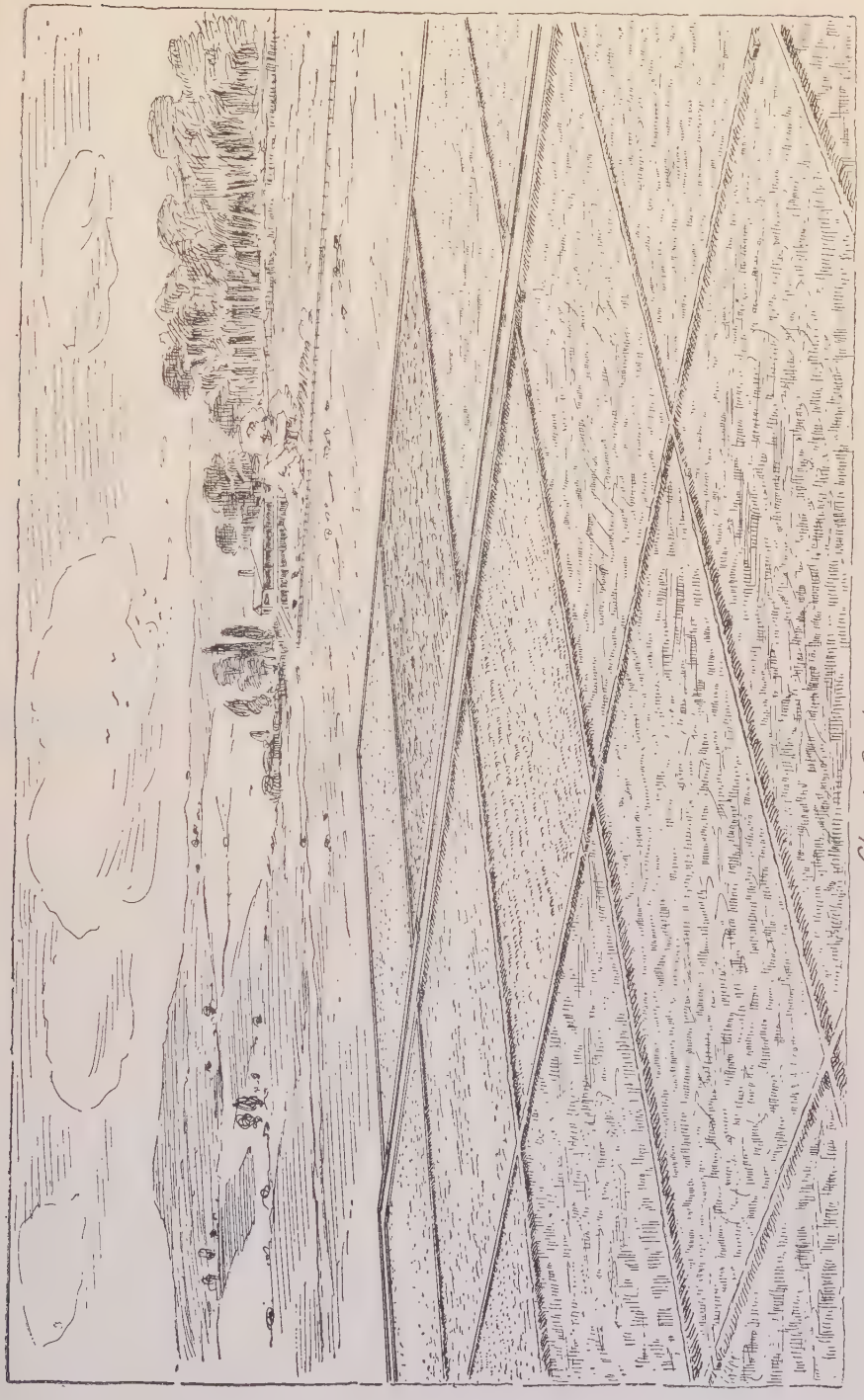
The Flooding Method.

Next to the furrow method the flooding method is probably the one best suited to the general conditions in this State. As no particularly good samples of this method appear to exist in this State at present, a description of the system is borrowed from "Farmers' Bulletin," U.S.A., Department of Agriculture, No. 373.

Flooding from field ditches or laterals is still the most common method of applying water to arid lands of Western America. In the States of Colorado, Montana, Wyoming, Utah, and to a large extent in Idaho, lucerne, clover, native meadows and grain are irrigated in this way. This manner of wetting dry soil originated, it is believed, in the mountain States, and the past half century has witnessed a gradual evolution of this plan; so that now it has not only become firmly established, but is regarded as the best suited to the conditions under which it is practised. It can be profitably used on slopes that are too steep for other methods. Fields having a firm soil and a fall of 25 feet in 100 feet have been flooded successfully. From this extreme the slope may diminish to less than 0·1 foot in 100 feet. Its cheapness is another feature which recommends it to the farmer of limited means. Ordinary raw land can be prepared for flooding at an expense varying from 8s. to 20s. per acre. Again, it is adapted for the use of smaller water supplies. In the mountain States the irrigation systems have been planned and built to deliver water in comparatively small streams for use in flooding or in furrows, and water users should be certain that the larger volumes required for checks and borders can be secured before going to the expense of preparing their fields for either of those systems.

In grading the land for this particular method it is not customary to make many changes in the natural surface. Only the smaller knolls are removed and deposited in the low places. An effort is made always, however, to make the farm laterals fit into the natural slope and configuration of the tract to be watered so as to bring the water to the high places. On steep slopes the laterals may be less than 50 feet apart; on flatter slopes they may be 200 feet or more apart. Whatever the spacing, it is always desirable to have the slope between them as nearly uniform as possible. When the land in its natural state is uneven, the grading can be done best by a buck-scraper, shown in Figs. 39 and 40. When this is used it is often advantageous to make use of some such implement, as shown in Figs. 41 to 44, for final smoothing and grading. If the field in its natural state is comparatively smooth and level, a home-made drag or leveller, such as shown in Fig. 49, will suit the purpose fairly well.

The distribution of the ditches in the field varies too widely to admit of presenting a standard plan, but Fig. 50 shows an arrangement of field laterals common to the mountain States. A supply ditch, A.B., is built on one side and laterals C.D. and E.F. branch out from it on a grade of 0·5 to 0·75 inch to the rod. These laterals are spaced 75 to 100 feet apart and are made with double mould-board ploughs either walking or sulky. Figs. 46 and 47 illustrate other common arrangements in use in Northern Colorado.



Check System Fig 48

In the vicinity of Fort Collins, Colorado, the main lateral is built to the highest corner of the field to be irrigated, and the smaller laterals extend out from it, spaced 75 to 225 feet apart, the spacing depending on the slope of the ground and the coarseness of the soil. The size of the laterals is governed by the head which may be had, but on steep slopes and on soil that erodes readily, small heads are best. Around Berthond, Colorado, the land is naturally of uniform, even slope, and little grading has been necessary. Heavy timber or iron drags are used to smooth the surface after ploughing, so that the water will spread evenly. These are built in various ways and out of whatever material happens to be available on the farm. Worn out steel rails, such as have been removed from a railway, are often used; two rails being fastened together about 30 inches apart. A team is hitched to each end and the driver rides on the drag. Once over a field with a drag of this kind is usually sufficient to make the surface quite uniform and smooth. The proper location for field laterals is usually evident to the irrigator without the use of survey instruments; though in fields where the fall is slight it is often necessary to have a topographical survey made and the laterals located by an engineer. Field laterals are always so located that they cover the highest parts of the field, and their distance apart in lucerne varies from 10 to 20 rods.

The head required for flooding from field laterals in Northern Colorado varies from 2 to 3 cubic feet per second, and is divided between two or three laterals. Canvas or coarse manure dams are used to check the water in the laterals, and to force it out over the banks and down the slopes of the fields. In less than three hours the upper foot of soil is usually thoroughly moistened. To apply one watering in this way costs from 7d. to 1s. 3d. per acre.

In flooding clover and lucerne fields in Montana, the field ditches usually run across the field on a grade of 0·5 to 0·75 inch to the rod. The spacing between ditches varies with the slopes, the smoothness of the surface, and the volume of the water, but 80 feet is about an average. The head used is seldom less than 1·5 or more than 4 cubic feet per second (560-1,500 gallons per minute), the larger heads being divided between two or three ditches. In irrigating, a canvas dam is first inserted in each ditch or set of ditches, 75 to 100 feet below the head. The water is then turned into each channel and flows as far as the canvas dam, by which it is checked, and as a consequence rises and flows over the low places in the low bank or through openings made with the shovel. When these small tracts have been watered the canvas dam is raised, dragged down the lateral 75 to 100 feet, and again inserted in the channel to serve the next tract. Manure dams sometimes take the place of the moveable canvas dams. Sometimes before a field is to be irrigated, and after the ditching is done, coarse manure is placed in small heaps within each ditch channel, at suitable intervals, and each heap is covered with earth on its upper face to a depth of about 2 inches. When this check has served its purpose it is broken and the water flows down until stopped by the next check. In some instances permanent wooden check boards are inserted in each lateral; whilst in others the canvas dam is used. The thorough irrigation of 4 acres is considered good work for a man during twelve hours. By the use of 2·25 cusecs two men can irrigate 7 to 10 acres in twenty-four hours, at a cost of 1s. 10d. to 2s. 9d. per acre.

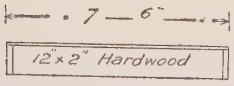
In the Salt Lake basin, the heads of water used by the irrigators of lucerne vary considerably with the flow of the streams. In spring, heads of 4 to 6 cusecs are common, while later in the season when the streams are low they are reduced to 1 to 3 cubic feet per second. A field is usually divided into strips 200 to 500 feet wide by laterals extending across it (Fig. 51). A permanent wooden check box or a canvas dam is inserted in the main supply ditch, below each cross ditch, causing the water to flow into the cross ditch. From there it is spread over the surface through small openings in the ditch bank, and any excess water is caught up by the next lower ditch. In this way each ditch serves a double purpose, acting as a drainage channel for the land above it and a supply channel for the land below it.

In summarising the advantages of the flooding method it may be said that in first cost it is one of the cheapest; it is adapted to the delivery of small volumes of water (1·25 to 2·5 cusecs) in continuous streams; it is particularly well adapted to forage and cereal crops of all kinds; the top soil is not removed from high places to fill up the low places; and firm soil, although it be on steep and irregular hill sides, can be successfuly watered.

The chief disadvantages consist in the fatiguing labour required to handle the water; the small area which one man can irrigate in one day; the difficulty in applying water after dark; and the unequal distribution on the field unless more than average care is exercised.

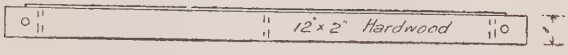
Drag or Leveller.

(Home made.)

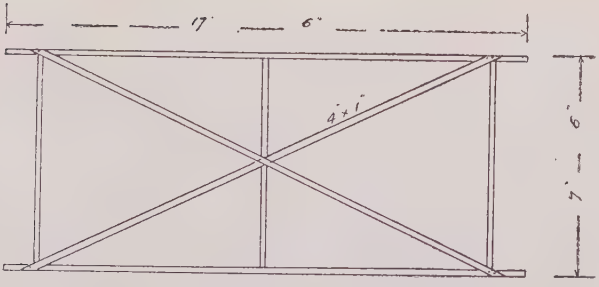


End

Fig. 49.



Side.



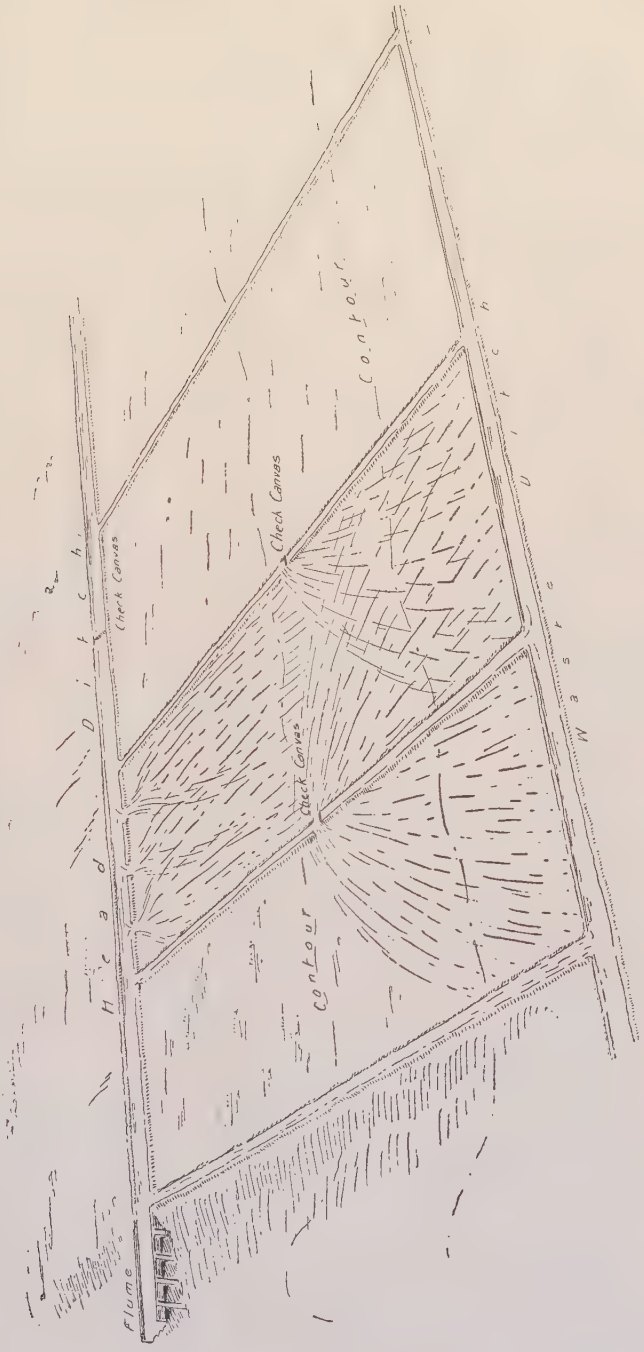
Plan.

Scale.

0 1 2 3 4 5 6 7 feet.

View shewing Land Irrigated by Flooding.

Fig 50.



Flooding from Head ditch.

Fig. 51.

Flooding Ditches, Flume, &c. Fig. 52.

THE ORANGE-TREE BUG (*Oncoscelis sulciventris* Stål.)

RECENT INVESTIGATIONS.

BY A. A. GIRAULT, Assistant Entomologist, Department of Agriculture and Stock, Queensland.

INTRODUCTION.

SINCE there has been considerable public attention drawn towards the presence of this insect in certain of the orangeries of the Blackall Range region of this State, and since there seemed to be some reason to think that it might become generally a serious menace to the fruit industry of that and perhaps other regions, the writer was deputed by the Entomologist-in-chief of this department to make an earnest investigation of the life of the insect and of means for controlling it, in continuance of his own work. Accordingly, in the late winter and early spring of 1923, this was entered upon, and as much information was gathered as the time allowed. This and what was previously known is summarised in the following pages.

HISTORY AND DISTRIBUTION OF THE INSECT.

A résumé of this will throw light upon where and when the insect has formerly occurred. It was first described as an insect new to science, under the name *Oncoscelis sulciventris,* by Stål in 1863, but apparently was not recorded as a Queensland insect until 1868, when F. Walker mentions a specimen in the British Museum that had been donated earlier by Mr. Gibbons.

In 1889, Tryon found it in Toowoomba damaging citrus orchards. He also referred to it as occurring there as a pest insect some years earlier; and recorded it from Cleveland, Stradbroke Island, Nundah, and North Pine. Olliff first found it in New South Wales in 1892; in 1901, Froggatt recorded it from the Richmond River and from the Tweed to Lismore. This office has since had evidence of its occurrence in Queensland at Gympie, Pomona, Marburg, Esk, Banyo, Beerwah, Boonah, Gowrie, Glamorgan Vale, Killarney, Greenmount, Montville to Mapleton, Oakey and Spring Bluff, all within the past decade or so. It is thus widely spread.

In the Blackall Ranges, the insect is now abundant only upon the top of the mountain between Mapleton and Montville; as soon as the lowlands are reached it is scarce.

NATURE OF THE BUG.

Insects are articulated or jointed animals, which when adult are 6-legged and usually winged, and which when young are either more or less wormlike or else resemble the form of the parent but bear no wings. The insect before us is of the latter kind, and belongs to a large group called bugs, familiar enough to most. Now bugs lay eggs,

and when these hatch the young are small but resemble, at least in essentials, the adult except for bearing wings. They grow by a succession of moults or sheddings of the skeleton or "skin" and pass through five stages in this manner, the wings gradually appearing in the last two like buds. The sixth stage is the winged adult form. Bugs have the mouth at the end of a long beak from the apex of the head, and feed by inserting an interior lancet or lancets into the plant.

The Orange Bug is a large kind known to those most concerned, but whose actual appearance it is impossible to describe non-technically. Accordingly a photograph of it is given (*see* Plate II).

DESCRIPTIONS OF THE STAGES.

The Egg.

The egg is described by Tryon as follows:—Spherical, glossy, pale, leaf-green, 2·5 mm. diameter. There is no special armature.

The Nymph.

Note.—The insect during each of the following five stages has its body depressed—flattened out:—

Stage I.—Length, 5 mm. Width, 3·5 mm. Oval, convex, delicate green, eyes red, *distal half* last antennal joint save *extreme* tip, black. In dried specimens, colour lemon. Last club joint somewhat exceeding the third. Glossy, glands indicated by four dark specks of which the cephalic two are twice larger and equal a dot on thorax midway between middle line and lateral margin.

Stage II.—Length, 6-8 mm. Width, 4-5½ mm. Subovate, flat, green, surface opaque; distal two-thirds last antennal joint save apex widely, brown, glands showing as four dots, all equal. No thoracic dot. *Sinus at extreme posterior end of body for first time distinct.*

Stage III.—Length, 8-11 mm. Width, 5·5-7 mm. The same. Last antennal joint black at distal two-thirds (except tip widely), the joint *subequal to 3.* Body often narrowly margined with black.

Stage IV.—Length, 11-15 mm. Width, 8-11 mm. The same general colour, now often all orange with a round black spot on last thoracic segment above and behind. Third antennal joint also coloured at more or less distal half. Lateral margin of body always black narrowly, this black widening at anal end. If coloured, then as in V.

Stage V.—Length, 17-21 mm. Width, 11-15 mm. Coloured usually as follows but variable:—Pink with apex of antennals 1, 3, and 4, a cinctus near base of 3 and nearly basal fourth of 4, white; also hind and

inner margins of the eyes and inner margin of the black edges of upper and lower body. Projection in front of eye, club, antennal 3 save as noted and reddish base, lateral margin narrowly of thorax and abdomen above and below, a large peltate mark apex of thorax dorsad, black. Anal margin body more widely black and not margined with white within.

The projection in front of the eye may not be black. Antennals 1-2, legs, head, and thorax may be green.

When just moulted into IV, the nymph is pure green, disk of abdomen yellow, black absent, the usual dark part of the club crimson. The thoracic spot varies greatly in III, as to its presence, shape, and so forth; this is also true of the black about the anus.

ANALYSIS OF THE NYMPHAL STAGES.

I. Hind margin of thoracic segments 2-3 straight or nearly, not produced into lobes. Smaller, green stages, body usually not margined with black. Third antennal joint not coloured.

1. Body convex; anal extremity without distinct sinus. Oval; distal half antennal 4 save extreme tip, black. Thorax with a black dot on each side above .. .. Stage I.

2. Body flat; anal extremity with distinct sinus. Subovate. Distal two-thirds antennal 4 coloured save apex widely. Thorax with no dot on each side above.

Body not margined with black; *distal antennal joint coloured with brown;* median spot on hind thorax above rarely present .. .. II.

Body often narrowly margined with black; *distal antennal coloured with black;* median spot of thorax more often present .. .. III.

II. Hind margin of thoracic segments 2-3 produced. Larger, coloured stages, body margined with black. Third antennal joint coloured.

1. Second thoracic segment convexly produced to cover the third near lateral margin. A narrow, transverse sclerite between segments 2 and 3 of thorax .. .. IV.

2. Second thoracic segment produced into a lobe which reaches to the middle of the second abdominal segment .. .. V.

THE ADULT.

The adult measures not quite an inch in length and when newly emerged is of a bronze colour, this becoming brown or reddish brown beneath. The last three joints of the feelers, the coxæ, and the feet or tarsi are crimson; most of the upper part of the head, the legs, the middle line of upper thorax, a narrow line along the black margins of the prothorax and all the under body except the head, the lateral margin of the horny basal part of forewing, and a spot on anterior-lateral corner of the triangular scutellum are pale green. The femora are black-dotted. The hind margin of the hardened basal part of the forewing and a large

round spot above near lateral margin of each of the last three segments but two of the abdomen are white. When the wings are removed, the disk of the abdomen above is seen to be crimson, darkening widely at the margins. This may serve as a warning colour. When dead, the greenish-red and pale markings have a tendency to fade into the general brown of the ground colour, so that the insect appears nearly of a brownish hue suffused more or less with red.

When just moulted the adult is grass green with pale-blue lateral margins, the abdomen pinkish.

The shape of the adult is oval; the head is small, fits into the front part of the thorax, and bears the rather long feelers or antennæ and centrally, from beneath the extreme anterior end, the beak. The latter lies along the venter between the first pair of legs, and consists of elongated mouth-parts so co-ordinated as to form a sucking organ.

The two sexes are very much alike, but the male is somewhat smaller and may be recognised by examining the belly. Here it will be found, in the female, that a middle channel extends to the anus, widening and deepening on the penultimate segment; at the posterior end of this channel is a large, smooth, convex piece, whose posterior margin is also convex centrally and nippled and at each corner with a dark, short, stout, hairy cornicle.

In the male there is no median channel, but the penultimate segment terminates in a median sinus with a slightly biparted cornicle on each side of it.

Characteristics of the Stages.

As a rule, the older this insect grows the more highly coloured it becomes. The first three stages are practically all green or greenish yellow; but, from the fourth stage, yellow, pink, and even reddish forms may predominate; the body is narrowly bordered with black, the third segment of the feelers or antennæ becomes coloured, and there is a prominent black spot in the middle of the thorax above, towards the abdomen (present rarely in II, frequently in III). The fourth stage may also be pure green edged with black.

The first stage is characterised by its small size, oval form, and by having the dorsal body humped more or less or convexed. The first three stages can be distinguished usually by their relative size but II and III are flat and, when gorged with food, only the abdomen is convex above. Stage I has a black dot on the last or third segment of the thorax midway between margin and middle line (from six cabinet specimens only); this does not occur in II or III.

Usually in II and III only the terminal joint of the antenna is dark—brown in II, black in III—while in IV and V the last two joints bear wide dark rings apically.

Stages IV and V are recognisable because of changes in structure—development of the wing-bud. Thus in IV the second segment of the

thorax is convexly produced to cover the third (near lateral margin), while in V the lobe of the forewing is conspicuous and reaches to the middle of the second abdominal segment.

There is considerable variation in colour in the later stages.

LIFE HISTORY OF THE ORANGE-TREE BUG.

Eggs are deposited on the trees during summer. These give rise to the first-stage insects, that according to Tryon live in that stage but a few (5) days.

The newly hatched bugs remain together in a cluster, perhaps for the whole durance of stage I, and feed little, if any, and will voluntarily detach themselves upon slight disturbance They then moult into II, and these latter, with very few exceptions, go into hibernation until the following spring. They disperse over the tree shortly after the moult.

This insect has now become established permanently in citrus orchards. It passes the winter still upon the foliage of the trees as just stated, in a state of semi-hibernation. That is, wherein feeding and activity have ceased, yet the insect is neither torpid nor incapable of motion. Though in the second stage of development from the egg, yet rarely a third or fourth stage individual occurs. The following table gives the data upon which this statement is based. It was gathered to the very time of observed emergence from hibernation.

TABLE TO SHOW STAGES OF WINTERING FORM—FLAXTON, 1923.

Date.	Stage II.	Stage III.	Stage IV.	Percentage in II.	Totals.
July 3	300	..	3	..	303
July 12-13	1,337	..	6	..	1,343
July 26 (Montville) ..	3,690	2	3	..	3,695
Aug. 18-29	5,324	..	9	..	5.331
Totals	10,651	2	21	99·8	10,672

This wintering form is flat and adheres closely to the under surface of the leaves, the antennæ together and directed straight forward. There may be more than one bug together, but usually they are isolated. When more than one occurs they are body to body but irregularly placed, except that they do not occur one upon the other. They are now quite languid and not, at least during the day, disposed to move; but there seems to be a general tendency for all to seek the leeward side of the trees as a protection from the westerly winds. A search made of the vegetation occurring in the orchard and the circumjacent ground revealed none except in the instance of a vine of Passion-fruit between two badly infested orchards, upon which large numbers had apparently passed the winter, and which were seemingly descendants of eggs deposited upon the vine. They did not seem to feed upon this vine.

If the trees are disturbed at this season the odour of these bugs can be detected, but if handled the latter do not stain the hands as is true when active and feeding.

During winter a tree may be badly infested and yet searched with the eye for minutes without seeing a single specimen, so flat are they and so closely pressed to the leaf surface, while their colour is near to that of the leaf.

EMERGENCE FROM HIBERNATION AND SUBSEQUENT DEVELOPMENT.

About the time that the orange trees commence their seasonal growth this insect no doubt is stimulated to activity, and by the time that the trees have several inches of succulent shoots it commences to crawl about, seeking the terminal and outer tender parts for the purpose of feeding. This activity was first brought to my attention by noticing that when handled the bugs stained the hands. This was on 29th August at Flaxton. Observation showed that a few were swollen as if from food, and by 3rd September following it was estimated that 33 per cent. were thus, feeding soon thereafter becoming general. They could then be seen upon the trees. When in this swollen condition, the II's are like, in form, the adults of the common housebug (*Cimex*).

The bugs have now changed their habits and live more or less exposed upon the outer parts of the tree, becoming noticeable and, as they increase in size, even conspicuous.

From the time that feeding commences, development advances rather slowly to the adult stage. The following table shows what progress it had made from the time of leaving hibernation, 29th August, to the appearance of the first adults. The II's gradually decrease as development progresses.

Date.	II.	III.	IV.	V.	Total.	Percentage in II.	Place.
1923.							
Aug. 29 ..	10,651	2	21	0	10,672	99·8	Flaxton
Sep. 7 ..	2,177	21	4	0	2,202	98·0	Montville
Sep. 17 ..	1,074 378	820 101	11 ..	2 ..	1,907 479	67·0	Montville
Sep. 26 ..	607	2,231	812	9	3,669	17·0	Montville
Oct. 24 ..	45	21	410	183	660	6·8	Montville

Thus, by the end of the first month of feeding, the great majority of the bugs had passed through one or two stages; about 20 per cent. were in stage IV, and in the vicinity of Brisbane (Banyo) this stage represented 40 per cent. of the insects by the end of the first week of October, while stage V had correspondingly increased. On the other hand, a large number of the II's at 26th September were still in the condition of the hibernating form—*i.e.*, flat, unfed. The first stage V to be seen was on 7th September (Montville) and the first adult on 24th October at the same place, 0·15 per cent. being in that stage at that time. Twenty-seven per cent. were in V at Montville, 24th October.

Supplementary observations made at Banyo and Flaxton in late October showed that in the former place on 21st October, 1923, the stages were as under:—

— —	II.	III.	IV.	V.	Total.
Percentages	3	13	61	23	100

Two days later adults were found at Brisbane.

This result agrees with Montville, 24th October. At Flaxton on 30th October, nearly a week later, the following:—

—	II.	III.	IV.	V.	Adults.
Number	55	48	448	507	1
Percentages	5·1	4·5	42	47	·094

So within a week the insects had passed from IV to V but adults had not increased much in proportion. Of the II's a large number were still like the hibernating form.

Later an opportunity was taken to make observations at Banyo on 11th November. One hundred and forty-four specimens were obtained from three old orange trees, of which 77 per cent. were V's, 18 per cent. IV's, 1·3 per cent. each III's and II's, and 0·7 per cent. adult (1 male). The II's were still flat.

This is as far as our observations take us, but judging from them we could expect adults in numbers not until late November, if quite so early. At Flaxton, 29th November, 1923, out of 335 units from one tree, 74 per cent. were in V, 19 per cent. IV, 3 per cent. adult, 1·7 per cent. II, and 1·5 per cent. III. Most of the II's were flat, unfed. The adults were commencing to mate.

This bug, therefore, develops at an unusually slow rate and it would appear that there is but a single generation during each year. This is readily understood when consideration is taken of the fact that this species will usually feed only upon new and tender growth, and after it has hatched from the eggs laid in summer does not, perhaps, find much of this. As far as we know, it therefore remains a short while in stage I and then, without having taken food, moults into II and then goes into hibernation.

Secretion and Excretion.

Like most bugs, this one secretes a colourless volatile liquid with a peculiarly disagreeable odour, and which moreover is an irritant and stain. It is a well-known fact that many of the volatile fluids given off by these large bugs will asphyxiate other insects and even reptiles, such as frogs, when these animals are placed into airtight receptacles. The

glands which secrete this fluid in the Orange Bug are four in number, situated on segments 3-5 almost in a central square upon the back of the abdomen, fed from a balloon-like oval, lemon-yellow reservoir in the dorsal body just beneath them and appearing as dots to the eye; in the first stage they seem to be absent but are represented by two unequal pairs of black dots. They apparently disappear in the adult but in that stage are situated on the under side of the thorax. The fluid is suddenly expelled in a solid stream.

When the fluid from these glands is thus squirted upon the tender parts of the skin a moderate stinging sensation is felt, and when it comes into contact with any part of the skin whatsoever the latter is deeply stained the colour of a cigarette smoker's fingers. The writer has had the inner surface of one hand deeply dyed in this manner for days at a time, but no injury resulted, and the stain quickly disappeared upon ceasing to handle the insects but would not wash off; the skin at the end of the fingers was somewhat roughened. Sharp pain is felt if the fluid enters a wound.

If any of the fluid enters the eye the irritation is much more serious; it first gives a sharp shock to the nerves and then causes tears to flow; so that it is best to protect the eyes with glasses or goggles if working about the trees when the insects have grown to the fourth stage and are very numerous. The secretion of this fluid is active upon slight disturbance as when the insects are approached closely.

In stage V this secretion is both more abundant and more active than with the earlier stages. It can then be squirted a foot (at least), usually sideways over the body. It stains more deeply now and is more irritant. When the bugs are being handled day after day, the skin of the fingers becomes a deep walnut colour or even blackish, and finally the skin splits and cracks at the tips and the quick of the nail becomes painfully inflamed. I have seen this stage "shoot" five times in succession.

Men working during this time banging the trees suffer more or less in other ways. Severe burns may be caused on the neck by reason of the fact that the bugs climb up the backs of those engaged in the operations, and the writer was shown a large blister upon the stomach due to a V getting into the shirt. I have also seen men with more or less spotted faces and with face sores, and have heard that even a finger nail has been lost and the sight temporarily in one eye; moreover, on account of being much exposed to an atmosphere of this volatile fluid, some had complained of becoming drowsy.

Despite the foregoing, however, no person fully clothed, and with goggles and gloves, need experience ill effects while banging trees infested with this insect in its older stages.

These insects excrete a colourless fluid (sometimes greenish) from the anus in the form of 1-2 globules, gently but quickly projected a short

distance; this, as experiment has shown, does not stain the skin, and, as far as known, is non-irritant. In V, as with the volatile irritant, it is more copious and is ejected in 4-5 drops or even in a stream.

When adults of either sex are closely approached they manœuvre as would a battleship and "shoot" the stream of fluid for two feet or more. The movement is lively and can be repeated more than once. The fluid is still more irritating and is ejected from a slitlike opening in the space between segments 2 and 3 of the thorax, to the side of the spiracle.

The fluid from the anus is also ejected by the adult in a solid stream. The adult and nymph V are nasty objects to handle.

Feeding Habits.

Observation has failed to find this insect feeding upon any other than new and tender growth, and tends to show that development will not take place, or else is much retarded, unless such growth is available. Experiment has shown that even on less vigorous trees development has been retarded, and even as late as the beginning of October insects upon stunted trees which had failed to put out new growth in the spring were still in the wintering stage. However, by the beginning of November these same insects had reached stage IV though the tree bearing them was still poor.

They subsist usually entirely upon sap drawn from the stems, leaf midribs, leaf petioles of the new growth, flower pedicels, and fruit pedicels; sometimes they may suck from the base of the very young fruit. Of their choice, not a great deal can be said at present. Of 269 observations made 27th September as to whether blossom or foliage was preferred, 142 or over half were found feeding upon blossom pedicels. All blossoms were not yet open, but some newly set fruit did not seem to attract them. The insect was then in stage III, 20 per cent. in IV.

When the nymphs are partly in III and partly in IV, in reference to foliage, over twice as many were found feeding upon leaf petiole as upon midrib; in reference to blossom the bud pedicel was most attacked. Twenty in a hundred attacked the stem. The data were not numerous. More nymphs face down or toward the tree trunk than up or from it, but III's seem to face down as a rule and IV's up. When there are no blossoms, the foliage suffices.

Nymphs IV have been observed to remain at food, without changing their attitude, for 6½ hours and the part fed upon did not wilt; observations made by Mr. J. H. Simmonds tend to show that they may remain thus much longer and that several days' continuous feeding may be usual, the leaf or bud not wilting until after a day or so. This is in reference to individuals, and needs confirmation.

Feeding is continued if the day turns cloudy and during the night, at least up to 10 o'clock.

When most of the nymphs are in stage IV (24th October; 22 per cent. in V) the feeding habit changes. The young fruit is then well set and

the leaves have been abandoned, only fruit pedicels and the stems being fed upon. Two hundred and twenty-four observations made on 24th October gave 58 per cent. on stem, the remainder on fruit pedicels.

It is at this time that the nymphs gather more or less into clusters upon the stem, their heads as close together as possible, sucking from one spot.

Injury Caused by Feeding.

One, two, three, or more nymphs clustered upon a leaf-stalk or other part, sucking the sap, soon tell upon its health. Before long, wilting commences, and, in the case of leaves, curling, gradual darkening, then dryness and death. The buds of fruit wilt and drop off, as is also the case with the tips of the stem and the young fruit. An infested tree, therefore, if the bugs are numerous, will soon bear a number of wilted, curled, and dead leaves. Wilted terminal growth will also show, and if this injury is considerable the foliage will have a more or less rusty appearance.

Method of Feeding.

When feeding the body is inclined up at the head end but not greatly. The lancets penetrate the plant only at their tips, and as a consequence the beak is but slightly bent and not released from the enclosed lancets: it is bent at the second articulation (apex joint 1), joint 1 inclines 45 deg. backward, 2 not quite as much up and forward, the rest nearly perpendicular. This position of the beak is perhaps necessary because the part to be penetrated has no depth. Later, in V and adult, joint 2 is inclined forward and down, and 3 and 4 nearly perpendicular (only a few observations).

The Adult.

This stage is reached not until late October or early November, and gradually is manifested by more and more individual insects. The following facts are taken from Tryon's article of the early part of this year, relating to observations made in January 1923. The newly moulted adults do not fly, and remain upon the trees perhaps for some days. In last mid-January nearly all the bugs were adults, 92 per cent. to be exact, in equal numbers as regards sex. They occurred mainly in clusters of from 2 to 10, rarely more; solitary females were noticeable, however. Flight was taken in the daytime if disturbed, especially with the solitary forms. They were still feeding upon the tender shoots. The females bore large ova even before mating occurred, and, these being associated with large nutritive cells, it accounts for the fact that the first nymphal stage can be passed (as supposed) without food being necessary, certainly exceptional. The adults when taking flight drop a few inches first; flight may be continued until the insect is out of sight.

The mating pairs are end to end. Of 296 adults captured at Flaxton, 29th November, 1923, 154 were females. Both sexes feed greedily. On

the date mentioned, of 66 V's, 44 were feeding upon fruit pedicels, 8 base of fruit, 9 on stem. Of 48 adults, 16 were feeding upon fruit pedicel, 17 base of fruit, 12 on the stem

THE EGG.

This stage is also unknown to the writer except as old, hatched masses. Tryon states that two females may deposit masses upon the same leaf, and that young leaves usually bear the eggs upon the under surface. Almost invariably the female lays 14 eggs in each mass, deposited side by side in rows. Usually these rows are 2-3-4-3-2, but considerable variation in this respect occurs. As the hatched eggs remain upon the trees for long periods, I was able to make the following observations upon them during the winter of 1923 at Flaxton:—

Of 223 masses observed during 3rd-4th July, 85 were upon the upper surface of the leaves, 138 or 61 per cent. upon the lower. Tryon's observations were confirmed as to the number per mass and so forth. As to the arrangement of the eggs in the mass, this was found very variable, as many as 22 different combinations being observed in addition to the one first described. They are deposited high or low upon the tree and sometimes upon small and undersized leaves. Mr. V. G. Pack. of Montville, showed them to the writer upon the leaves of Passion-fruit in an orchard. Two masses, deposited side by side, may be joined so as to appear as one. Tryon states the eggs hatch after 8-9 days, and are then quite colourless. No doubt, the adults live several months and egg-laying therefore occurs over a relatively long period, more than one mass being produced.

NATURAL ENEMIES.

There are several predaceous bugs which attack this insect, and a number of birds, including the black-and-white flycatcher and the domestic turkey and fowl, but at the present time at least these do not materially aid the grower. For further particulars, *see* Tryon (1923a, p. 106). In November, at Flaxton, an Asilid was observed with a captured nymph V.

NATURAL HABITAT.

This insect, we are informed by Tryon, is a native of the scrub, living upon native Citraceæ allied to the Orange. No evidence as to this has yet been obtained by the writer.

BEHAVIOUR OF THE INSECT IN REFERENCE TO MEANS OF CONTROL.

1. *Nymphs Not Easily Dislodged in Winter.*—This has been shown experimentally; in the case of one tree more than thrice the number came down upon the fourth than upon the first jarring, the largest number upon the third. In the case of a second tree, twice as many came down at the second jarring as with the first. The trees were banged as described later.

2. *Nymphs Easily Dislodged in Spring.*—On 26th September, when the bugs were 60 per cent. III's, two trees were jarred by Mr. V. G. Pack, with the following result:—

	First Banging.	Second Banging.	Percentage Dropped for First.
Tree No. 1	2,064	197	91
Tree No. 2	1,282	127	90

It is noteworthy here that, of the 324 bugs obtained by the second banging, 47 per cent. were II's; in the first banging only 12 per cent.

On 24th October, when the nymphs were 61 per cent. IV's, a tree was banged as under:—First banging, 614, or 93·1 per cent; second banging, 46, or 6·9 per cent. II's in the first were but 5 per cent.; the second, 25 per cent. of the whole.

The nymph II is dislodged from the tree with greater difficulty than any other nymphal stage.

3. *Habits of the Nymphs II-V when Dislodged from Trees.*—Dropping onto the ground in an irregular manner, some upon their backs, the bugs soon orientate themselves in the direction of the trunk of the tree. The habit in respect to this, of the wintering form, is thus:—When dislodged from the trees, these wintering forms fall to the ground and lie for a while quite still as if dead, but after several minutes they make slow movements and, if upon their backs, languidly move their legs. Then they remain quiet for a longer time, whereupon a general movement to the tree commences from all directions towards the trunk. They crawl slowly and often are overturned and sometimes blown back by the wind. The movement is, of course, uneven and irregular, and the foliage is not regained until five or six hours have elapsed. In the many cases noticed, not a single movement away from the tree was seen. During the colder parts of the day, the wintering nymphs, if upon the ground, will not move but remain overnight and wait until the warm portion of the day, when they will commence to crawl. Those of the older stages move more rapidly, as is to be expected. When thrown to the ground they do not avoid the light. In the active season, they commence to crawl toward the trunk almost immediately, more especially those in the sun, and reach the tree much sooner than with the wintering form; but the active II's are much slower in reaching the tree than the larger III's and IV's. Their motion is slower and less continuous if the ground beneath the trees is weedy.

If dislodged in the hot part of the day (from 10 a.m. on) some of the larger forms perish from exposure to the sun, but only those which, falling upon their backs, could not regain their feet and as a consequence had the tender under parts fully exposed.

The following experiment, performed by Mr. J. H. Simmonds, confirms this:—At 9.50 a.m., 26th September, five III's and ten IV's were

taken in good health and placed upon their backs on smoothed ground beneath a tree in full sunlight. At first all struggled to regain their feet (the few succeeding were turned back, sometimes twice or more). By 11·08 all were stupefied, legs contracted over ventum, but occasional spasmodic twitches of antennæ and tarsi occurred. At this stage they were removed to shade, and by 3 p.m. were commencing to dry and change colour, evidently dead.

4. *The Nymphs Can Climb Inclines of Smooth Soil.*—Of ten nymphs (three II's and seven III's) placed at the bottom of a pit whose sides formed an incline of smooth fine soil of 8 inches length, four escaped within a half-hour, including one II; the rest perished from exposure and over-exertion. In practice, mounds about the base of the tree seem to be effective barriers against IV's and V's; because, being at first retarded in gaining the tree, new arrivals crowd in and struggling prevents advance.

5. *The Bugs Not Inclined to Travel in Heat.*—On two occasions, twenty nymphs (II and III) were placed upon open ground in the sun at 11 o'clock and 9.30 a.m. In the former case, general movement did not commence until after 3 p.m., the bugs settling down upon pieces of straw and small weeds. In the latter case some movement took place before 11 o'clock, but from that time the insects were more or less at rest until 4 p.m., when movement began. Further observation is desirable.

6. *Tropisms.*—The nymphs, at least stages II and III, react to contact and will climb sticks and so forth if they meet them, often remaining for hours upon the top of such. They also appear to be attracted by the orange odour. They do not avoid the light by hiding.

7. *Burial Experiment.*—On 17th September, at 5 p.m., many healthy II's and III's were buried in a narrow pit 3½ inches deep, made into the red soil of an orchard. After twenty-four hours there was no change. Exhumation was made after one week, finding that all were dead. The experiment was twice repeated. It is quite evident that burial is fatal to nymphs. The soil was not packed in the experiment but levelled down.

8. *Temperature of the Ground at Night Not Fatal to Hibernating Forms.*—In early July, at the suggestion of Mr. H. Morris, about thirty nymphs were placed in a hollow scooped in the soil; this was at 4 p.m., when it was commencing to be cold. The nymphs were quite inactive as if semi-torpid. By the following morning at 9 o'clock they were unchanged, but an hour later they began to crawl out of the hollow and soon disappeared.

9. *Film of Kerosene upon Water Fatal.*—This has been observed, and the fact is useful if it is desired to scoop up the living insects and to kill them by throwing them into pails.

10. *Nymphs V Easily Precipitated from the Tree.*—In stage V the insects are as readily precipitated by banging as when in III or IV; it is stage II that clings so much to the tree. The largest nymphal stage is also as readily affected by sprays.

MEASURES FOR CONTROL.

Preliminary Statement.

Before this inquiry was inaugurated, nearly every means of control now known to be practised against insects was either tried or proposed against this one, and there was great confusion existing in the minds of growers and others as to which of these were effective or were not so and whether any were so.

Most had agreed, however, upon one means of greatly diminishing its numbers—namely, by what is called "banging" the trees, a certain though sometimes tedious process, in which by jarring the limbs and branches the insects are precipitated to the ground, and by banding the tree-trunk to prevent climbing are then dealt with.

In the following statement, summaries are given of the experiments performed in connection with this inquiry. These included all those most likely to prove practicable.

Summary of Spraying Experiments.

Heretofore there has been nothing but confused opinion in regard to the efficacy of various sprays against this insect. But careful observation has shown that it is more hardy than was to be supposed, and the collection of data from sprayed trees soon revealed the fact that no spray yet tried had been sufficiently effective.

For the purpose of classification, those tried which did not kill at least 35 per cent. of the insects are called ineffective. The following proved to be of this class when given a preliminary trial:—Solomia, Benzol Emulsion (Vallo Brand); Harbas and Petroleum Emulsion (all failed in laboratory tests); Lime-sulphur Wash (Vallo Brand); Black Leaf 40; Nicotox (Vallo Brand); Kerosene Emulsion (1-7 and 1-14); Black Leaf 40—Resin Wash; Resin Wash (1 lb. resin, ½ lb. washing soda, 4 gals. water); Kerosene Soap—Kerosene Emulsion; and Resin—Kerosene Emulsion (1 and 2 qrts. Kerosene Emulsion).

Of those called effective, the results in percentages of killed were as follows:—

	Per cent.
1. Kerosene Emulsion—Resin Wash, greatest strength (3 qrts. Kerosene Emulsion)	36 (2 trials)
2. Carbolic Mixture (a new unnamed proprietary remedy)	39
3. Kerosene Soap (Campbell's Soap Mixture)	45
4. Katakilla*	52
5. Derosene—Solomia*—Resin Wash	37
6. Bouille Labordi*	60 (2 trials)
7. Resin and Ammonia	35

* Proprietary insecticide.

Of the above the Bouille Labordi is the only one which gave practical results and these not very good. But it and Nos. 2 and 7 injured the tree rather much. There remain Nos. 3 and 4 and these would have to

be twice applied. All were used upon the active bugs (II-IV) except the first eight listed under the ineffectives; these latter were used upon the hibernating bugs, which ought to be the more hardy.

When bugs after being precipitated to the ground by fumigation were sprayed with kerosene emulsion (1-4) about 60 per cent. average were killed (three trials), and the same result or nearly was obtained with the same at strength 1-6 (three trials) and with cattle dip (one trial, Carbolised Cattle Dip, Thomas, 2 oz. to 3 gals. water). This statement applies to immature insects only.

Summary of Fumigation Experiments.

The use of hydrocyanic acid gas was recommended against this insect years ago and is the most promising of all the insecticides yet given trial. It is to be regretted, however, that weather in the form of wind interfered with a part of the experiments, so affecting the result as to make them contradictory. So that additional and more carefully gathered data are needed before definite statements concerning this method of treatment can be given.

However, even at the usual dosage, fumigation for ten minutes brings down 80 or more per cent. of the population of the trees, while twenty minutes' exposure or longer brings down from 90 to 100 per cent. So that the use of this gas can be substituted for banging if it is so desired.

It appears that it is subsequent exposure which kills most of the insects when this gas is used, because, if taken indoors just after they were treated, the majority would recover. The use of bands about the tree-trunk are still necessary in conjunction with it.

The following table summarises the results in percentages of mortality:—

Hydrocyanic Acid Gas Fumigation.

	Exposure, minutes.							
	10	15	20	25	30	35	45	60
Usual dosage	*28	..	*43 *46	61 .. 73 80	64 75	60 ..	56 78	69 91
25 per cent. increase ..	..	..	*56 *65 *66	80 89				
50 per cent. increase ..	..	*51 *52	*73 ..	*58 *67 *68 90 93				
75 per cent. increase ..	*28 *53	..	76 80					

The numbers starred indicate those experiments which were performed during windy weather; the results therefore uncertain.

SUMMARY OF BANGING.

Growers, then, have the choice of three things—(1) spraying twice with one of the above indicated sprays (they have not been thoroughly tested); (2) the gas treatment plus cincturing; or (3) banging and cincturing.

The latter operation is strongly recommended for the present as being 85 per cent. effective if thoroughly and energetically put into practice. It merely remains to be stated when and how to do it.

The operation is very simple. It requires but a padded mallet, some fly-paper for cincturing the tree-trunk, and some tacks for fastening the paper. As Tryon (1923a) has already described the method, and as the ingenuity of the individual grower is usually equal to simple emergencies of this kind, it is unnecessary to put further stress upon it. However, the cincture is of so much importance that it ought to be emphasized that the paper for it has to be purchased, as only the Tanglefoot brand of fly-paper can as yet be recommended. There is no known preparation that can take its place. The insects should not be allowed to crowd over it, but when this is likely, as with badly infested trees, should be scooped up and put into pails of water filmed with kerosene oil. The cincture is useless unless the banging is done at the right time, early spring. However, when the insects reach V, they can cross the paper, and in place of cinctures the earth can be mounded about the base of the tree. But banging should have been completed before this time.

Banging requires that all the main and secondary branches be struck with the mallet, and some experience will be necessary before efficient practice is attained. The mallet should be rather heavy and very well padded. It is not essential to strike hard but sharply, so gauging that the insects come down, but not tree-growths, such as buds and so forth. The ground about the trunks of the trees during the operation ought to be clear of weeds and rubbish.

Early spring is the time for this operation, as has already been stated by Tryon in the place just cited. It ought to be started some short time after the insects have emerged from hibernation or after the renewal of tree-growth in the spring, when this emergence takes place; and concluded as rapidly as may be, at least before stage V becomes abundant. This would be, as a rule, before the swelling of fruit blossoms.

When the insects are in III and IV is the most favourable time to attack them, as they are most easily dislodged and blocked at that time; and then the trees bear no growths that can be easily jarred off. Moreover, at this stage, the repugnatorial glands are not so formidable.

As no single application of a fluid is as yet effective, banging is the most desirable alternative.

Sufficient labour ought to be employed in any repressive measure against this insect, so that the operation can be carried through in a proficient manner and within the time required.

Co-operation.

Owing to the power which the adult has of flight, it is certainly most desirable that banging or any other repressive measure or measures be made a communal operation, so that, becoming a matter of orchard routine, no single orangery can become overstocked with the insects to menace neighbouring ones.

Co-operative effort has already been strongly emphasized by Tryon.

ACKNOWLEDGMENTS.

I am indebted to Mr. H. Morris, of Flaxton, for a great deal of assistance, and to Messrs. S. Bray and V. G. Pack, of Montville, for allowing the use of trees in their orchards, and to Mr. Pack especially for assistance both manual and mental. Messrs. J. W. Ward, G. Williams, and A. Peters, of this department, were kind enough to co-operate in regard to some of the spraying, and all of the fumigation experiments, those initiated by themselves and from which considerable data were obtained. Mr. J. H. Simmonds, of this office, has given valuable and efficient assistance in the entomological part of this inquiry.

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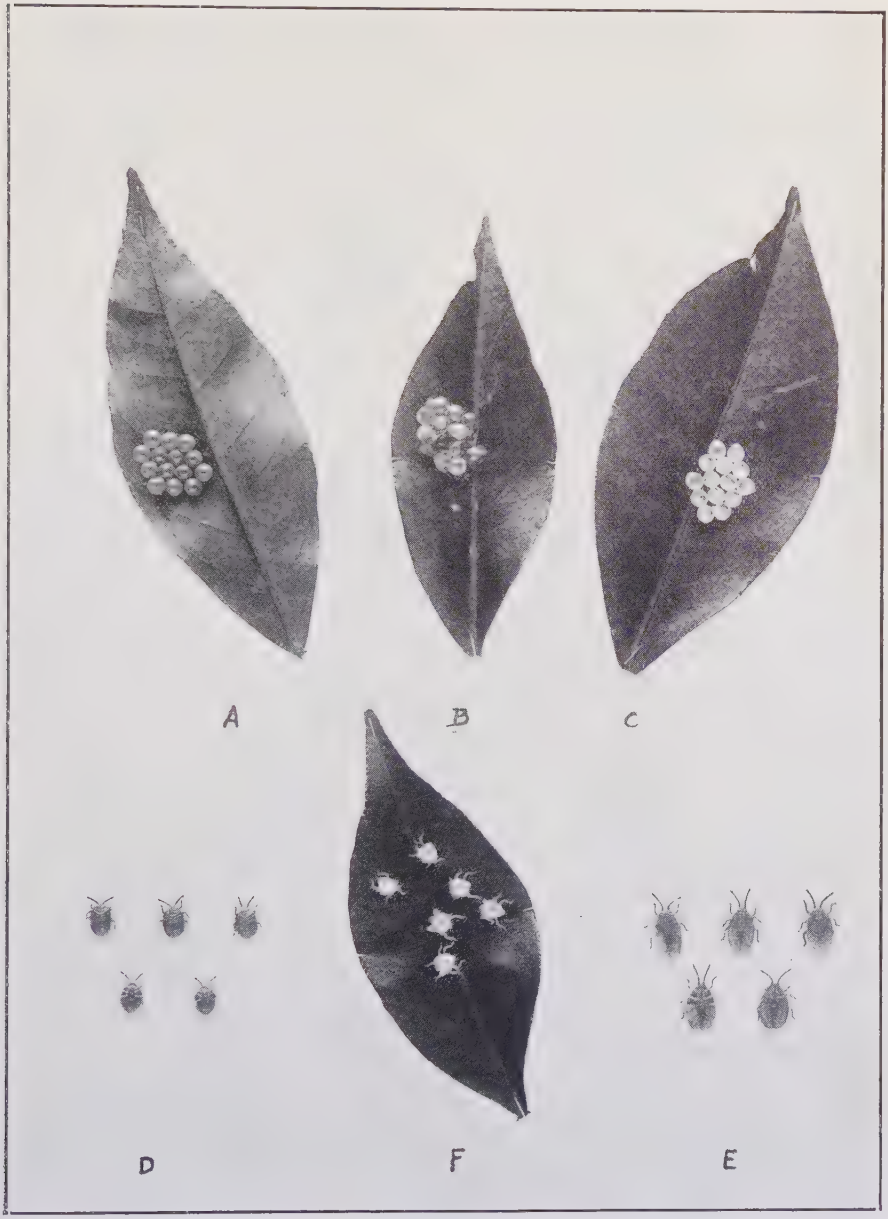
LIST OF PLATES.

I. A, B, C, D, E, F. Eggs and succeeding development up to larva II.

II. Plate of larval stages II-V in groups, showing variation in size of each stage, cast skins (smallest figures in each group), and adults (bottom row).

III. Larvæ upon an orange shoot, showing nearly natural positions, mostly IV's-V's.

IV. Orange shoot showing characteristic early injury to tender foliage.



ORANGE-TREE BUG. *Oncoscelis sulciventris* Stål.

A.—Eggs.
B.—Larvæ emerging.
C —Empty shells.
D.—First-stage insects.
E.—Second-stage Insects.
F.—Skins cast by first-stage insects.

ORANGE-TREE BUG. *Oncoscelis sulciventris* Stål.

Dep. Agr. & Stk., Qd. Div. Ent. & Pl. Path. Bull. No. 1 (*New Series*). PLATE III.

ORANGE-TREE BUG. *Oncoscelis sulciventris* Stål.

ORANGE-TREE BUG. *Oncoscelis sulciventris* Stål.

RECENT OBSERVATIONS ON INSECTS INJURIOUS TO COTTON.

By F. G. HOLDAWAY, B.Sc., Entomological Branch.

Following is a brief report on two insects which recently caused considerable damage to cotton seedlings in the Rockhampton district by attacking the foliage.

Specimens of tiny caterpillars, together with insect eggs on the seed leaves, and from the soil at the base of the seedlings, were received by this Office on 21st November, 1923, from Mr. W. L. Guy, of Rockhampton. The material was handed over to me for observation. Further material was received from Mr. G. B. Brooks, Instructor in Agriculture at Rockhampton, and Mr. A. A. Girault, Assistant Entomologist of this Office, who visited the Rockhampton district in this connection. The work of determining the species of these pests and of collecting information on their life histories has progressed sufficiently far to warrant this preliminary report.

Agrotis, sp. (?)

The specimens received from Mr. Guy belonged to a single species, and the eggs both from the soil and from the cotyledons or seed leaves gave rise during the days following to larvæ of the same species. The majority of the other specimens also belonged to this species, which, from Mr. Girault's report, constituted the main infestation, and were also attacking various weeds and young corn.

The Egg.—The eggs were whitish to cream-coloured; those found on the cotyledons occurred in clusters of from two to seventeen eggs, situated for the most part on the upper surface near the edges of the leaves. The eggs were almost spherical, and measured about ·7 mm. in diameter, and were prominently ridged with numerous vertical and less prominent transverse ridges.

The Larva.—Immediately after hatching the larvæ were just over 1 mm. or about 1/20 in. in length, and were whitish, soon becoming cream-coloured with a greenish tinge after feeding. It was in this first larval stage that most of the larvæ were received in the Office. Their appearance offered no clue as to the identity of the adult insect. The head and thoracic shield were brown. All the setæ or hairs on the head and body were glassy-white and characteristically swollen or clubbed at their extremities. The longest were equal in length to half the width of the body, and those occurring on the body arose from conspicuous dark spots.

The larvæ have been reared in the Office, and the larval period has been shown to consist of seven stages involving six moults or castings of the skin. As the larvæ underwent the various moults and increased in size, the clubbed hairs became less conspicuous, and changes occurred in colour, the larvæ gradually passing from cream to reddish-brown to greyish-brown in the full-grown specimens. The mature larvæ were greyish-brown with a pair of dark lines with indistinct margins in the mid-dorsal region, and a pair of inconspicuous dark lines in the dorso-lateral region. The head was brown and the thoracic shield dusky.

From observations of the later larval instars it can now be stated quite definitely that the original caterpillars were the first larval stage of a cutworm—*i.e.*, the stage before they had taken on the habit of living in the soil and causing damage in the manner so characteristically described by their common nomen. The larvæ grew to a length of from 40 to 45 mm. or 1¾ inches when extended in life.

The Pupa.—The larvæ previous to pupation formed a cell in the soil in which the change to the pupa or chrysalis took place. The chrysalis was brown and naked.

The most advanced larvæ have just pupated and no moths having yet emerged, the species cannot with certainty be named, though probably it is a species of *Agrotis*. Meanwhile the work in connection with the detailed life history of this cut-worm is being continued.

Neocleptria punctifera, Wlk.

Included in the material brought into this Office by Mr. Girault were a few caterpillars of a different species, which he had also observed attacking the cotton seedlings.

The larvæ were received in stages varying in length from 2 mm. to 1¼ c.m. The smallest showed signs of being about to moult and probably belonged to the first larval instar. The larvæ have been bred through their various stages in the laboratory. The moth has recently emerged and has been submitted to Dr. A. Jeffries Turner for determination. He has identified it as *Neocleptria punctifera* Wlk., family Noctuidæ. The genus Neocleptria is one very closely allied to that of Chloridea (Heliothis) to which the adult of the Cotton Boll Worm or Maize Worm belongs.

The Larva.—In general appearance the young larvæ are cream-coloured and shiny. The head and thoracic shield are jet black. The dorsum of the body is pale cream-coloured with a longitudinal irregular brownish marking in the dorso-lateral region. The setigerous spots are prominent, jet black and bear black setæ or hairs. The three pair of true legs are black as also are the four pair of abdominal prolegs and the pair of caudal prolegs. The anal plate is also black.

The larval period is passed through in six stages or instars involving five moults.

The Full-grown Larva.—The caterpillar grows to about 3 c.m., or just over 1 inch in length, when it is very different in appearance from the newly hatched larva. In general appearance it is almost black with yellowish and yellowish-green markings on the dorsal surface and with a longitudinal lateral band of canary yellow. The ventral region is dull green. The more detailed description of the larva is as follows:—The head is brown mottled with dark markings. The prothorax is practically concolourous with the rest of the body, except the thoracic shield which is yellowish-green mottled with brownish black. On the body, situated mid-dorsally, is a longitudinal black band with a narrow median yellow line. The dorso-lateral region is also black. Between these two is a yellowish-green area containing whitish irregular lines and in which are situated the dorsal setæ. In the thoracic region the yellowish-green area is bounded on both sides with yellow, but on the abdomen it merges laterally into the dorso-lateral black band. Laterally there is a conspicuous longitudinal canary yellow band in which the black spiracles or breathing pores

PLATE 8.—*Neocleptria punctifera*, Wlk.

A.—Ventral view of moth. B.—Chrysalis. C.—Dorsal view of moth.
All natural size.

are situated. Ventrally the larva is dull green. The setigerous spots are jet black, those situated dorsally being largest, and all bear white setæ. With a strong lens the body is seen to be finely tuberculate, being covered with tiny, short, spinelike projections which catch the light and give the larva an almost tinsel-like appearance.

The Pupa.—Pupation takes place in the soil, the larva forming a kind of loose cocoon of soil, the exact nature of which is as yet imperfectly understood owing to paucity of material. The chrysalis is brown and possesses posteriorly a pair of spines separated at the base but meeting at the tip.

The Moth.—The adult insect is a moth belonging to the family Noctuidæ. It measures 1·3 mm. from head to tail. The body, in the thoracic region, is light brown in colour, and in the abdominal region is light greyish. When at rest the fore wings practically conceal the hind wings, and the anterior margins of the fore wings make with each other an angle of about 45 degrees. The wings slope downwards slightly towards the sides, and when extended measure 30 mm. from tip to tip. The fore wings are cream-coloured, tinged pink, with markings of copper brown. The hind wings are pale cream-coloured, with the veins and broad apical band almost black. The fringe of the hind wings is white. On the under surface the wings are whitish with dark apical bands. Situated on the under surface of the fore wing is a black kidney-shaped spot, corresponding in position to a dark brown kidney-shaped spot on the upper surface, near the anterior border a little more than half way from the base of the wing.

After an examination of the Office files, I can find no previous record of this insect having been found attacking cotton in Queensland.

General Notes.

The Co-operative Associations Act.

"*The Primary Producers' Co-operative Associations Act of* 1923" came into force by Proclamation on 15th December last.

Staff Changes and Appointments.

Mr. H. H. Bentley has been appointed Representative of the Council of Agriculture on the Egg Pool Board, as from the 10th December, 1923.

Mr. D. A. Logan has been appointed Government Representative on the Carpentaria Dingo Board in place of W. C. Woodhouse, transferred.

Mr. S. H. Frazer has been appointed Government Representative on the Aramac Dingo Board, and Messrs. F. A. Allen, F. W. Briggs, L. N. K. Munro, and E. W. Bayliss have been elected members of that Board.

Mr. P. W. Amos has been appointed an Honorary Inspector under the Diseases in Plants Act.

Messrs. J. C. Brünnich, E. H. Gurney, G. R. Patten, and W. G. McKechnie have been appointed Analysts under "*The Pest Destroyers Act of* 1923," and the officers under-listed have been appointed Inspectors under the same Act:—F. F. Coleman, F. B. Coleman, A. H. Benson, G. Williams, F. G. Connolly, W. J. Ross, J. Henderson, W. Leslie, T. Lowry, S. C. Todd, J. A. Stockdale, C. G. Williams, F. W. Becker, W. Maggs, and E. F. Duffy.

The Officer in Charge of Police, Jundah, has been appointed an Acting Inspector of Stock.

T. McMahon, Police Constable, has been appointed an Inspector of Slaughter-houses.

Mr. J. B. Hennessy has been appointed an Officer under and for the purposes of "*The Animals and Birds Act of* 1921."

Mr. A. H. Scott has been appointed Government Representative on the Cook Dingo Board, and Messrs. N. V. Collins, W. Atherton, G. J. McIvor, and F. Lawrence have been elected members of that Board.

Scientific Farming -The British Empire Exhibition and Agriculture.

The Ministry of Agriculture and Fisheries is co-operating with the National Farmers' Union and the National Milk Publicity Council to put before visitors to the British Empire Exhibition at Wembley this year a display that wll convey an adequate picture of the history, progress, and possibilities of land cultivation in the home countries.

The Ministry, which has been allotted space in the British Government Section, is making it its business to show how the State has helped and is still helping agriculture by enabling it to take advantage of the results of modern scientific research. There is to be a 240 feet range of show cases containing experimental subjects and samples of home products of the soil. Many phases of agricultural activity will be displayed on the cinematograph, and some of the country's leading authorities on scientific agriculture will be at Wembley to explain things. Among them will be Professor Biffin, the world authority on wheat, who will give lectures from time to time.

There is endless cause for wonder at the application of electricity to the growing of grain. This is a field of actual achievement as well as of vast possibilities. This, among other things, will be made easy for laymen to understand at the British Empire Exhibition.

The Farmers' Union and Milk Publicity Council are making themselves responsible for a completely equipped exhibition of dairy farming. They are erecting a dairy, 100 feet by 70 feet, and a cowshed, 30 feet by 70 feet, in which forty cows of the finest breeds will be housed, and the most modern methods of milking will be shown. Visitors to the dairy will see how from milk there comes butter, many varieties of cheese, dried milk, condensed milk, milk sugar, and dried casein.

It is, perhaps, not generally known that casein is the basic milk-product from which umbrella handles, electric light bowls, buttons, hair combs, and decorative charms are made. The methods of making these things will be shown.

It is hoped through the Exhibition to educate the public to an increased consumption of milk. America drinks three times more milk per head of the population per day than Great Britain. She is wise enough to recognise its great food value.

Points for Poultrymen.

The following practical points for poultry breeders are taken from "The Poultry Bulletin" for 16th November, 1923:—

Feed early.
Don't forget grit.
Dry houses prevent roup.
Grit is a disease preventive.
Sour food causes bowel troubles.
The healthy hen is a hearty eater.
Scratching hens means laying hens.
Buy your next season's breeders now.
Too much raw meat produces worms.
Keep the broody hens out of the flock.
None but the best birds should be kept on hand.
Remember that hens require a variety of food.
Sell off the old hens before they begin to moult.
Better have your birds a trifle hungry than overfat.
Do not let any surplus cockerels eat up the profits.
One variety of poultry will pay better than four or five.
The nests require fully as much cleaning as the roosts.
Feed liberally, and don't forget animal food in some shape.
It does not pay to neglect colds or other minor complaints.
Poultry soon become accustomed to regular hours of feeding.
The egg yield is not influenced in any way by the male bird.
Clean the poultry house every day now that the days are longer.
The hungry hen seldom discriminates in the selection of her food.
We should always endeavour to profit by our past experience.
It is the little things in the poultry business which count for much.
Cull, cull, cull. Better a hundred layers than a thousand loafers.
An egg two days old is worth twice as much as when two weeks laid.
Do not throw away old broken plaster or mortar. Put it in the poultry yard.
Fresh eggs find ready buyers and command respect. Bad eggs cause trouble.
One of the greatest detriments to winter egg production is lack of exercise.
See that your water fountains are filled twice daily during the hot weather.
Regularity in feeding is just as essential as feeding on the right kind of food.
None but experienced poultrymen are justified in keeping more than one breed.
To undertake to breed from any other than healthy birds is to fail, and fail miserably.

Filth and vermin is the greatest combination against success in the poultry business.

Overfeeding and improper feeding are fruitful causes of weakness in the breeding stock.

When sending eggs to market do not place them in dirty cases or put in undersized eggs.

Always have the water fresh. This applies to the supply for all classes of feathered stock.

The dry mash, with hard grain in litter, is proving to be the most economical method of feeding.

Keep the chickens away from damp places and watch closely for any signs of roup or diarrhoea.

No other stock will pay as poorly as the hens if neglected, or as well if extra care is given.

Never allow sick fowls to be with the balance of the flock; many poultry diseases are contagious.

There is always a demand for really good birds, and these birds always command a good figure.

Fowls prefer the dust bath moist, not dry. They will use it more frequently if this feature is provided.

Once a reputation for straight dealing and dependence is built up there will be no lack of good customers.

The only secrets in the poultry business are common sense, absolute cleanliness, good feeding, and pure air.

Until you learn to be patient you will not attain to the full measure of success. Slow but sure is the safe road to follow.

Success in the poultry business as well as any other comes largely from being prepared for emergencies as they appear.

The poultry business is not adapted to sluggards. The lazy man loses money with hens. Every neglect in poultry raising has its cost.

Do not make the mistake of purchasing "culls" to begin with; there is no greater mistake in connection with the industry than this.

Birds intended for the show pen should have free range, proper food, and fresh water in order that they may be kept growing every minute.

Don't altogether trust to luck in this busy age. We must use plenty of sand, grit, energy, gumption, horse sense, and elbow grease.

Poultry neglected during summer will be slow at going into profit during the season of the year when prices for eggs will be interesting.

If you do not keep the dropping boards clean you had better not have any. The dropping board is a danger if left to acumulate filth.

There are some who put a good deal more work into chicken raising than is necessary, while others do not give them the care they require.

It costs no more to keep good straight thoroughbred stock than it does to keep mongrels, and there is much more profit in it in the long run.

Feeding a flock of fowls with a scoop shovel is not hard work, neither has it ever produced anything remarkable in the way of results.

If there were no other argument in favour of keeping fowls on the farm, the single one of helping to market the bulky products should be sufficient.

Go light on maize during the hot weather, both with young and old poultry. Provide dry feed, plenty of fresh water, dusting material, and good shade.

Don't forget that the lice are as anxious to kill your little chicks as you are to raise them. The only way to beat the lice is to use your superior intelligence.

The chief requisite in breeding layers is first-class, healthy, vigorous stock. Such birds, well managed, and properly fed, cannot fail to produce good layers.

Much of the success of a poultry venture is due to the work at the business end. Careful buying and selling will make a material difference at the end of the year.

The early-rising poultryman not only gratifies the wishes of his stock, but he is able to feed and water them, and clean up the droppings, while the air is still cool.

To have either old or young birds thrive, they must be comfortable. While we may not entirely succeed in this particular, we can do considerable towards having them in a happy state.

Like any other business, the work of poultry raising has to be learned before it can be carried on successfully, and there is far more to be learned in the care and management of fowls than many suppose.

The important work among growing chickens is to thin out the flocks and separate the sexes. Overcrowding is a common cause of slow growth, and the bullying of pullets by cockerels and older birds is fatal to their development.

Enforcement of the Diseases in Plants Act.

The Acting Premier (Hon. W. N. Gillies), in referring recently to a deputation that asked for the compulsory collection and destruction of fallen fruit in the orchards in the Stanthorpe district, principally towards aiding the destruction of the fruit fly in that district, said he welcomed the request of the deputation because it supported the similar action taken by the Department in 1922, and also because it indicated a practical wish on the part of the growers to as far as possible get rid of the fruit fly and clean up the orchards. A commencement was directly made by an advertisement in the newspapers circulating in the district notifying growers that it is intended to enforce the regulation under the Diseases in Plants Act requiring that fruit, whether diseased or not, shall not be allowed to lie on the ground; but instead that it shall be gathered forthwith and diseased fruit destroyed by boiling or otherwise. Inspectors in the district have been instructed to be especialy vigilant. If any grower disobeys an order from an inspector to cleanse his orchard, a prosecution will immediately follow. Already it has been necessary to initiate a prosecution for failing to obey such an order. The Act provides for the issue of an order which is in reality a warning that the law must be carried out, consequently, anyone who fails to obey an order must be quite aware that he is acting at his own risk and cannot reasonably complain if the law is set in motion against him.

PLATE 9.—A VEGETABLE FREAK—A CUCUMBER FROM MR. W. COLTMAN'S FARM, MELANDAH.

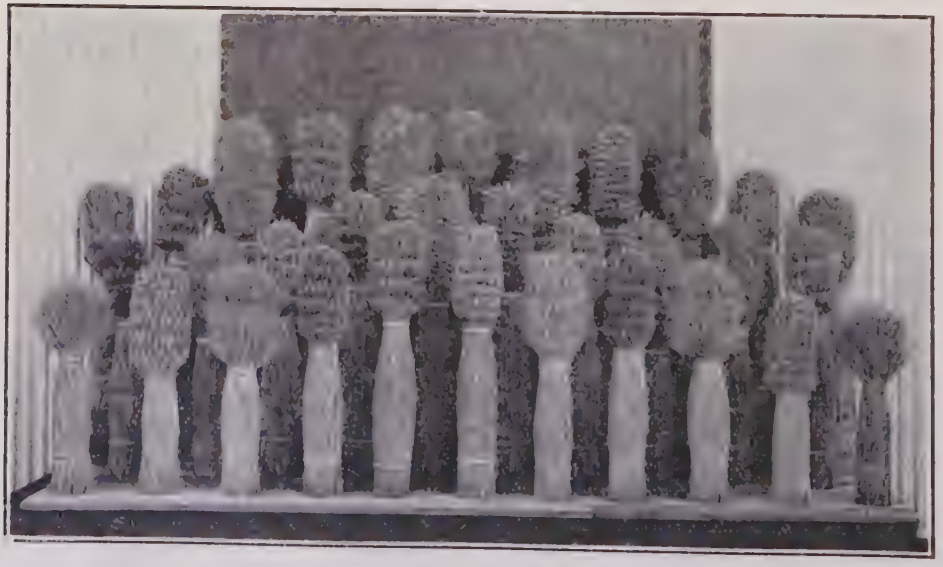


PLATE 10.—QUEENSLAND WHEAT SHEAVES FOR THE EMPIRE EXHIBITION

Orchard Notes for February.

THE COASTAL DISTRICTS.

February in coastal Queensland is frequently a wet month, and, as the air is often heavy with moisture and very oppressive, plant growth of all kinds is rampant, and orchards and plantations are apt to get somewhat out of hand, as it is not always possible to keep weed growth in check by means of cultivation. At the same time, the excessive growth provides a large quantity of organic matter which, when it rots, tends to keep up the supply of humus in the soil, so that, although the property looks unkempt, the fruit-producing trees and plants are not suffering, and the land is eventually benefited. When the weed growth is excessive and there is a danger of the weeds seeding, it is a good plan to cut down the growth with a fern hook or brush scythe and allow it to remain on the ground and rot, as it will thereby prevent the soil from washing, and when the land is worked by horse power or chipped by hand it will be turned into the soil. This is about the most satisfactory way of dealing with excessive weed growth, especially in banana plantations, many of which are worked entirely by hand.

The main crop of smooth leaf pineapples will be ready for canning, and great care must be taken to see that the fruit is sent from the plantation to the cannery with the least possible delay and in the best possible condition. The only way in which the canners can build up a reputation for Queensland canned pineapples is for them to turn out nothing but a high-class article. To do this they must have good fruit, fresh, and in the best of condition.

The fruit should be about half-coloured, the flesh yellowish, not white, of good flavour, and the juice high in sugar content. Over-ripe fruit and under-ripe fruit are unfit for canning, as the former has lost its flavour and has become "winey," while the latter is deficient in colour, flavour, and sugar content.

For the 30 or 32 oz. can, fruit of not less than 5 in. in diameter is required, in order that the slices will fit the can, but smaller fruit, that must not be less than 4 in. or, better still, 4¼ in. in diameter, and cylindrical, not tapering, can be used for the 20-22 oz. can.

Bananas for shipment to the Southern States should on no account be allowed to become over-ripe before the bunches are cut; at the same time, the individual fruit should be well filled and not partly developed. If the fruit is over-ripe it will not carry well, and is apt to reach its destination in an unsaleable condition.

Citrus orchards require careful attention, as there is frequently a heavy growth of water shoots, especially in trees that have recently been thinned out, and these must be removed. Where there are facilities for cyaniding, this is a good time to carry out the work, as fruit treated now will keep clean and free from scales till it is ready to market. Citrus trees can be planted now where the land has been properly prepared, and it is also a good time to plant most kinds of tropical fruit trees, as they transplant well at this period of the year.

A few late grapes and mangoes will ripen during the month and, in respect to the latter, it is very important to see that no fly-infested fruit is allowed to lie on the ground, but that it is gathered regularly and destroyed. Unless this is done, there is every probabilty of the early citrus fruits being attacked by flies bred out from the infested mangoes.

Strawberries can be planted towards the end of the month, and, if early-ripening fruit is desired, care must be taken to select the first runners from the parent plants, as these will fruit quicker than those formed later. The land for strawberries should

be brought into a state of thorough tilth by being well and deeply worked. If available, a good dressing of well-rotted farmyard manure should be given, as well as a complete commercial fertiliser, as strawberries require plenty of food and pay well for extra care and attention.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

The marketing of later varieties of peaches and plums, and of mid-season varieties of apples and pears, as well as of table grapes, will fully occupy the attention of fruitgrowers in the Granite Belt, and the advice given in these notes for the two previous months, with regard to handling, grading, packing, and marketing, is again emphasised, as it is very bad policy to go to all the trouble of growing fruit and then, when it is ready to market, not to put it up in a manner that will attract buyers.

Extra trouble taken with fruit pays every time. Good fruit, evenly graded and honestly packed, will sell when ungraded and badly packed fruit is a drug on the market. Expenses connected with the marketing of fruit are now so high, owing to the increased cost of cases, freight, and selling charges, that it is folly to attempt to market rubbish.

During the early part of the month it will be necessary to keep a careful watch on the crop of late apples in order to see that they are not attacked by codlin moths. If there is the slightest indication of danger, a further spraying with arsenate of lead will be necessary, as the fruit that has previously escaped injury is usually that which suffers the most.

Fruit fly must also be systematically fought wherever and whenever found, and no infested fruit must be allowed to lie about on the ground.

Grapes will be ready for market, and in the case of this fruit the greatest care in handling and packing is necessary. The fruit should never be packed wet, and, if possible, it is an excellent plan to let the stems wilt for a day at least, before packing. This tends to tighten the hold of the individual berries on the stem and thus prevent their falling off.

In the western districts, winemaking will be in progress. Here, again, care is necessary, as the better the condition in which the fruit can be brought to the press the better the chance of producing a high-class wine.

Where necessary, citrus trees should be given a good irrigation, as this will carry on the fruit till maturity, provided it is followed up by systematic cultivation so as to retain a sufficient supply of moisture in the soil.

Farm Notes for February.

Reference was made in last month's Notes to the necessity for early preparation of the soil for winter cereals, and to the adoption of a system of thorough cultivation in order to retain moisture in the subsoil for the use of crops intended to be raised during the season. The importance of the subject, and its bearing in relation to prospective crop yields, is made the excuse for this reiteration.

The excellent rains recently experienced should have a heartening effect on all farming operations, as a good season may now be reasonably expected.

Special attention should be given to increasing the area under lucerne (broadleaf Hunter River), wherever this valuable crop will grow. Its permanent nature warrants the preparation of a thorough tilth and seed bed, and the cleansing of the land,

prior to sowing the seed, of all foreign growths likely to interfere with the establishment and progress of the crop. Late in March or early in April is a seasonable period to make the first sowing, providing all things are favourable to a good germination of seed.

Dairymen would be well advised to practise the raising of a continuity of fodder crops to meet the natural periods of grass shortage, and to keep up supplies of succulent fodder to maintain their milch cows in a state of production. Weather conditions, particularly the recent heavy and continuous rains, have interfered a great deal with farming operations. Although abundant supplies of grasses are in evidence, provision should be made for the inevitable period, at maturity, when these lose their succulence.

Many summer and autumn growing crops can still be planted for fodder and ensilage purposes. February also marks an important period as far as winter fodder crops are concerned, as the first sowings of both skinless and cape barley may be made at the latter end of the month in cool districts. Quick-growing crops of the former description suitable for coastal districts and localities, where early frosts are not expected, are Soudan grass, Japanese and French millet, white panicum, liberty millet, and similar kinds belonging to the Setaria family. Catch crops of Japanese and liberty millet may also be sown early in the month in cooler parts of the State, but the risk of early frosts has to be taken.

Maize and sorghums can still be planted as fodder and ensilage crops in coastal districts. In both coastal and inland areas, where dependence is placed largely on a bulky crop for cutting and feeding to milch cows in May and June, attention should be given to Planters' Friend (so-called Imphee) and to Orange cane. These crops require well-worked and manured land; the practice of broadcasting seed for sowing at this particular season encourages not only a fine stalk but a denseness of growth, which in itself is sufficient to counteract to some extent the effect of frost.

In the majority of agricultural districts where two distinct planting seasons prevail, the present month is an excellent time for putting in potatoes. This crop responds to good treatment, and best results are obtainable on soils which have been previously well prepared. The selection of good "seed" and its treatment against the possible presence of spores of fungoid diseases is imperative. For this purpose a solution of one pint of formalin (40 per cent. strength) to 24 gallons of water should be made up, and the potatoes immersed for one hour immediately prior to planting the tubers. Bags and containers of all kinds should also be treated, as an additional precaution. "Irish blight" has wrought havoc at times in some districts, and can only be checked by adopting preventive measures and spraying the crops soon after the plants appear above the ground. Full particulars on the preparation of suitable mixtures for this purpose are obtainable on application to the Department of Agriculture, Brisbane.

Weeds of all kinds, which started into life under the recent favourable growing conditions, should be kept in check amongst growing crops; otherwise yields are likely to be seriously discounted. The younger the weeds the easier they are to destroy. Maize and other "hoed" crops will benefit by systematic cultivation. Where they are advanced, and the root system well developed, the cultivation should be as shallow as possible consistent with the work of weed destruction.

First sowings may now be made of swede and other field turnips. Drilling is preferable to broadcasting, so as to admit of horse-hoe cultivation between the drills, and the thinning out of the plants to suitable distances to allow for unrestricted development. Turnips respond to the application of superphosphate; 2 cwt. per acre is a fair average quantity to use when applied direct to the drills.

Where pig-raising is practised, land should be well manured and put into good tilth in anticipation of sowing rape, swedes, mangels, field cabbage, and field peas during March, April, and May.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S.

TIMES OF SUNRISE AND SUNSET.

AT WARWICK.

1924.	JANUARY.		FEBRUARY.		MARCH.	
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Sets.
1	5·1	6 49	5·25	6 46	5·46	6·23
2	5 2	6 50	5 26	6·46	5·47	6 22
3	5·3	6 50	5·27	6·45	5·47	6·21
4	5·3	6 50	5 28	6·44	5 48	6 20
5	5 4	6·50	5 29	6·43	5·48	6 19
6	5 5	6 51	5·30	6·43	5 49	6·17
7	5 5	6·51	5 30	6·42	5·49	6 16
8	5 6	6 51	5 31	6 41	5 50	6·15
9	5·6	6·51	5·32	6 40	5 50	6·14
10	5·7	6·51	5 33	6·39	5·51	6·13
11	5·8	6·51	5 33	6·39	5·51	6 12
12	5·9	6·51	5 34	6·38	5·52	6 11
13	5·10	6 51	5 35	6 38	5·53	6·10
14	5·11	6·51	5 36	6·37	5 54	6 9
15	5·12	6 51	5 36	6·36	5·54	6 7
16	5·12	6·51	5 37	6 35	5·55	6 6
17	5 13	6 51	5·38	6·35	5 56	6·5
18	5·14	6 50	5·38	6 34	5·56	6 4
19	5·15	6 50	5·39	6·33	5 57	6 3
20	5·16	6 50	5 40	6·32	5·57	6 2
21	5·16	6·50	5·40	6 32	5·58	6 0
22	5·17	6 50	5·41	6·31	5·58	5 59
23	5·18	6 49	5·41	6 30	5·59	5 58
24	5·19	6·49	5·42	6·29	5·59	5·57
25	5 20	6·49	5 42	6·28	6·0	5 56
26	5·20	6·48	5·43	6·27	6·0	5 55
27	5·21	6·48	5 44	6 26	6·1	5·53
28	5·22	6·47	5 45	6 25	6·1	5 52
29	5·23	6·47	5·45	6·24	6·2	5 51
30	5 24	6 46	...	...	6·2	5·50
31	5·25	6·46	...	...	6·3	5·49

PHASES OF THE MOON, OCCULTATIONS, &c.

The times stated are for Queensland, New South Wales, Victoria, and Tasmania, when "Summer" Time is not used.

6 Jan.	●	New Moon	10 48 p.m.
14 „	☾	First Quarter	8 45 a.m.
22 „	○	Full Moon	10 57 a.m.
29 „	☽	Last Quarter	3 53 p.m.

Perigee 4th Jan., at 8·12 p.m.
Apogee 16th Jan., at 2·42 p.m.

On 1st January, at midday, the earth was 3,000,000 miles nearer to the sun than it will be on 3rd July at 11 p.m. Mercury will be at inferior conjunction with the sun on the 13th at 2 p.m. The moon will pass above the planet Neptune on the 24th at 7 p.m., at an apparent distance of about three times its diameter.

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5 Feb.	●	New Moon	11 38 a.m.
13 „	☾	First Quarter	6 9 a.m.
21 „	○	Full Moon	2 7 a.m.
27 „	☽	Last Quarter	11 15 p.m.

Apogee 13th Feb., at 11·42 p.m.
Perigee 26th Feb., at 1·54 a.m.

The planets Venus and Uranus will be apparently remarkably close to one another on 1st February, Venus being the uppermost. On the 5th Mercury will be at its greatest elongation west of the sun at a distance of 25½ degrees. Neptune will be at its highest position about midnight on the 9th. Mars and Jupiter will seem to be remarkably close to one another on the 14th at about 3 a.m. There will be a total eclipse of the moon in the early hours of 21st February, when the moon will enter the earth's umbra or darker shadow a little after midnight. It will be totally eclipsed between about 1·20 a.m. and 2·57 a.m., and will leave the umbra about 4 a.m.

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6 Mar.	●	New Moon	1 59 a.m.
14 „	☾	First Quarter	2 50 a.m.
21 „	○	Full Moon	2 30 p.m.
28 „	☽	Last Quarter	6 24 a.m.

Apogee 12th March at 7·54 a.m.
Perigee 24th March at 3·12 a.m.

On 5th March a partial eclipse of the sun will be visible in parts of South America and South Africa, but not in Australia. The planet Uranus will be in conjunction ith the sun, which will pass between the earth and Uranus, on the 8th at 6 p.m. Jupiter will be at quadrature with the sun on the 9th at midnight. Being west of the sun, it will be visible from about midnight to dawn.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhere about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

[All the particulars on this page were computed for this Journal, and should not be reproduced without acknowledgment.]